COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Nos. 3501 - 3600
1990 August - 1991 May

EDITORS: L. Szabados and K. Olah
KONKOLY OBSERVATORY
H-1525 BUDAPEST
P.O. Box 67, HUNGARY

HU ISSN 0374 - 0676

CONTENTS

3544 BV LIGHT CURVES AND THE FIRST EPHEMERIS FOR THE ECLIPSING BINARY STAR NSV 1776
G. Boistel, R. Boninsegna, M. Dumont
21 November 1990

3545 NO "CHROMOSPHERIC ACTIVITY" SEEN IN Eta And
K.G. Strassmeier, J. Hron
28 November 1990

3546 "NOVA" PQ And - FURTHER OUTBURSTS
G.A. Richter
5 December 1990

3547 THE X-RAY SOURCE 1E1615.0+3114 IS AN ECLIPSING BINARY
R.M. Robb, F.W. Dean, C.D. Scarfe
5 December 1990

3548 PHOTOMETRY OF CAPELLA (Dec 1981 TO Apr 1990)
K. Krisciunas, E. Guinan
6 December 1990

3549 uvby OBSERVATIONS OF THE ALGOL-TYPE STAR V1156 CYGNI
C. Friedemann, H.-G. Reimann
2 January 1991

3550 SIMULTANEOUS TWO-COLOUR OBSERVATION OF THE FLARE STAR EV Lac IN AUGUST 1990
A. Karapetian, V. Zalinian
2 January 1991

3551 1987-1989 UBV PHOTOMETRY OF OO AQUILAE
O. Demircan, E. Derman, F. Ekmekci
4 January 1991

3552 TIMES OF MINIMUM LIGHT FOR 17 ECLIPSES OF 7 DETACHED BINARIES
D.B. Caton, W.C. Burns, R.L. Hawkins
7 January 1991

3553 DISCOVERY OF RAPID OSCILLATIONS IN HD 19918
P. Martinez, D.W. Kurtz
10 January 1991

3554 FIRST PHOTOELECTRIC LIGHTCURVES IN TWO COLORS AND IMPROVED ELEMENTS FOR V482 Per AND V651 Cas
F. Agerer, D. Lichtenknecker
16 January 1991

3555 PHOTOELECTRIC LIGHT CURVE IN TWO COLOURS AND IMPROVED ELEMENTS FOR V724 AQUILAE
F. Agerer, D. Lichtenknecker
16 January 1991

3556 CG CYGNI REDUX: MORE 1989 BVR DATA
D. Beckert, S. Gordon, E. Jaderlund, E. Mann, M. Zeilik
17 January 1991

3557 MISCLASSIFIED RV TAURI STARS
E. Zsoldos
18 January 1991

3558 SPORADIC PHOTOMETRY OF PLEIONE
J.D. Fernie
28 January 1991

3559 A NEW FORECAST FOR HS HERCULIS
I. Todoran
4 February 1991

3560 BINARY SYSTEM 44i BOOTIS
G. Oprescu, M.D. Suran, N. Popescu
4 February 1991

3561 SPECTROSCOPIC OBSERVATIONS OF FIVE F SUPERGIANT STARS
S. Tamura, M. Takeuti
11 February 1991

3562 ON THE DELTA SCUTI PERIOD-LUMINOSITY RELATION
J.R. King
11 February 1991

3563 THE LONG-TERM BEHAVIOUR OF MWC 560
R. Luthardt
14 February 1991

3564 LIGHT CURVES FOR AB DORADUS
T. Banks
15 February 1991

3565 ON SOME MISTAKES IN THE 4th EDITION OF THE GCVS
E.V. Kazarovets
20 February 1991

3566 ON TWO POSSIBLE GROUPS OF PULSATING BLUE STRAGGLERS WITH DIFFERENT MASSES IN GLOBULAR CLUSTERS
M.S. Frolov
20 February 1991

3567 FLICKERING IN CATACLYSMIC VARIABLES WITH BRIGHT ACCRETION DISKS
A. Bruch
25 February 1991

3568 NATURE OF VARIABILITY OF VV Scl
P. Renson
1 March 1991

3569 RECENT MINIMA AND IMPROVED EPHEMERIDES FOR THE ECLIPSING HOT SUBDWARFS LB 3459 (= AA Dor) AND BD -7d3477 (= HW Vir)
D. Kilkenny, M. Harrop-Allin, F. Marang
7 March 1991

3570 1988 AND 1989 PHOTOMETRY OF UZ LIBRAE
P.A. Heckert, M.A. Hickman
8 March 1991

3571 WR 22 IS AN ECLIPSING BINARY STAR
E. Gosset, M. Remy, J. Manfroid, J.-M. Vreux, C. Sterken, L.A. Balona, G.A.P. Franco
8 March 1991

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3501

Konkoly Observatory
Budapest
8 August 1990
HU ISSN 0374 - 0676

HD 90892: A NEW VARIABLE IN HYDRA

While engaged in an observing program devoted to the study of the long-term light variations of Be stars, it was noted that one of the stars chosen as a comparison was in itself variable. This star, HD 90892, was found to change irregularly in V magnitude from 50 observations over the time period JD 2447124-8015 by a range of approximately 0.247 V magnitudes.

Differential BV photometry of HD 90892 was obtained with 3 separate observing systems. The majority of magnitudes were taken with the 0.6-m. telescope of the Corralitos Observatory and its uncooled single channel photon-counting photometer. The 5 magnitudes on JD 7182-6 were derived from the Kitt Peak Observatory's #2 0.9-m. telescope and its automated 1P21-based filter photometer. Finally, Stromgren by magnitudes were obtained on JD 7938-9 with the Lowell Observatory 1.1-m. telescope and red photometer. These were then transformed to BV magnitudes. Observations of a sufficient number of standard stars with the Kitt Peak and Lowell Observatory photometric systems allowed their magnitudes to be well integrated with those from the Corralitos.

Three comparison stars were utilized to derive magnitudes for HD 90892. Initially, HD 91120 (V=5.583; B-V=-.028; B9 IVe) and HD 90045 (V=6.592; B-V=+.497; F6/7 V) were chosen. Despite the fact that HD 91120 is a Be star and potentially variable, its magnitude was found to be entirely constant during the time period of observation. Therefore, its use as a comparison star was justified.

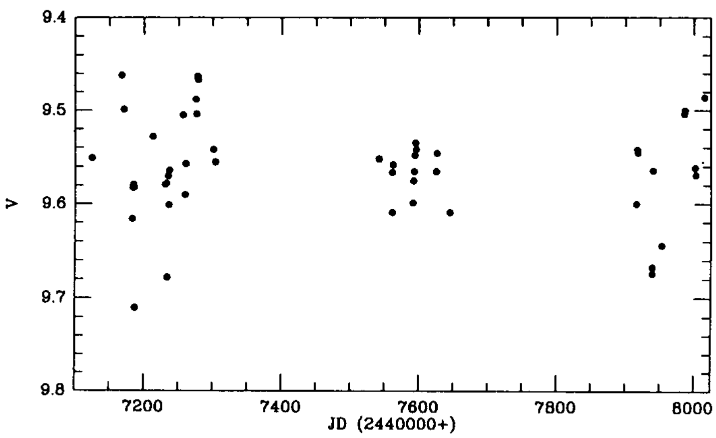


FIGURE 1: V MAGNITUDES FOR HD 90892

In the last observing season another comparison star (HD 91816; V=8.040; B-B=+.860; K3 V) was added in an attempt to provide a fainter star for the observations. The mean standard errors in V and B-V for the comparison stars were 0.017 and 0.015 magnitudes respectively.

Figure 1 presents the V changes for HD 90892, and Table I the magnitudes themselves. Clearly, the star is variable in V, though perhaps not in B-V (mean B-V = +.371 $\pm$ .020).

Previous history for HD 90892 is quite sparse, undoubtably due to its relative faintness. It does not appear in either the GENERAL CATALOGUE OF VARIABLE STARS or the CATALOGUE OF SUSPECTED VARIABLES. The only published spectral type would appear to be that of Houk & Smith-Moore (1988) who give A1/2 V + (G/K) composite. No other references could be located with the exception of a spectral type of A2 V from Buscombe & Foster (1990).

The type of variability which HD 90892 displays is at present considered to be irregular or unknown, and perhaps derives from some consequence of binarity or from variations of the G/K companion. An analysis for possible periodic behavior was carried

TABLE I

JD	V	B-V	JD	V	B-V
7124.9933	9.551	+.390	7541.8250	9.552	+.375
7167.8944	9.462	.370	7560.8499	9.609	.359
7170.8606	9.499		7560.8660	9.566	.379
7182.9184	9.616	.399	7561.8035	9.558	.373
7183.8852	9.582		7590.7597	9.599	.386
7184.8921	9.579	.392	7591.8222	9.575	.395
7185.8950	9.582	.397	7592.8063	9.565	.378
7186.9103	9.710	.406	7593.7443	9.548	.391
7212.8287	9.528		7594.7417	9.535	.376
7230.7733	9.579	.392	7595.7597	9.542	.323
7232.7545	9.578	.341	7624.7049	9.565	.396
7233.7559	9.678	.358	7625.6507	9.546	.384
7234.7747	9.570	.342	7644.6660	9.609	.374
7235.7441	9.601	.391	7915.8486	9.600	.378
7236.7691	9.565	.388	7916.8812	9.542	.389
7256.7039	9.505	.339	7917.8618	9.545	.401
7259.7038	9.590	.386	7938.8151	9.667	
7260.7058	9.557	.405	7938.8521	9.674	
7275.6744	9.488	.346	7939.7877	9.564	
7276.6715	9.504		7952.7028	9.644	.386
7277.6895	9.463		7985.7021	9.504	
7278.6776	9.467	.346	7986.6986	9.500	
7300.6731	9.542	.399	8001.7326	9.561	
7303.6583	9.555	.377	8002.6819	9.569	.392
7540.8674	9.552	.375	8015.7278	9.486	

out using the Minimum Phase Dispersion Method of Stellingwerf (1978) for the range in possible periods of 0.5 to 396 days. A possible period of 55.052 days was indicated, though not strongly. Examination of the phase diagram for that period showed unconvincing regularity. Therefore, at present it is considered that no periodicity was found.

HD 90892 would seem to be an interesting star to examine for spectroscopic changes in view of its relatively large photometric range.

Sincere thanks are rendered to C. Gullixson and T. Kreidl for their assistance with the Lowell telescope and photometry system.

E.M. HALBEDEL

Corralitos Observatory
P.O. Box 16314
Las Cruces, NM 88004
U.S.A.

REFERENCES

Buscombe, W. & Foster, B.E. (1990) MK SPECTRAL CLASSIFICATIONS, 8TH GENERAL CATALOGUE (Evanston: Northwestern Univ.).

Houk, N. & Smith-Moore, M. (1988) MICHIGAN CATALOGUE OF TWO-DIMENSIONAL SPECTRAL TYPES FOR THE HD STARS (Ann Arbor: Univ. of Michigan).

Stellingwerf, R. (1978) Astrophys. J., 224, 953.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3502

Konkoly Observatory
Budapest
8 August 1990

HU ISSN 0374 - 0676

HD 97305: A NEW VARIABLE IN LEO

While engaged in an observing program devoted to studying the possible long-term light variations of supergiants, it was discovered that one of the stars utilized for comparison purposes was variable. This star, HD 97305, was found to vary over a V range of 0.375 magnitudes from 28 observations.

Differential BV photometry was obtained for HD 97305 with 3 telescope-photometer systems. The major portion of the work was done with the 0.6-m. telescope and uncooled single channel photon-counting photometer of the Corralitos Observatory. 5 magnitudes each in B & V were contributed from the Kitt Peak Observatory's #2 0.9-m. telescope and automated filter photometer with its 1P21 photomultiplier tube. Finally, Stromgren by magnitudes were obtained on three nights with the Lowell Observatory 1.1-m. telescope and red photometer. Sufficient standard stars were observed with all the systems so as to allow meaningful intercomparison of the magnitudes. Standard stars also allowed the transformation of the Lowell by magnitudes to BV.

The comparison stars chosen for HD 97305 were HD 98502 (V=7.694; B-V=+.984; K0) and HD 98217 (V=6.841; B-V=+.922; G5). The average standard errors about the mean in V and B-V for these comparison stars were 0.014 and 0.023 magnitudes respectively.

Figure 1 shows the magnitudes graphically for HD 97305 and Table I details the values. The star would appear to be a variable in both V and B-V. There is a tendency towards brightening and

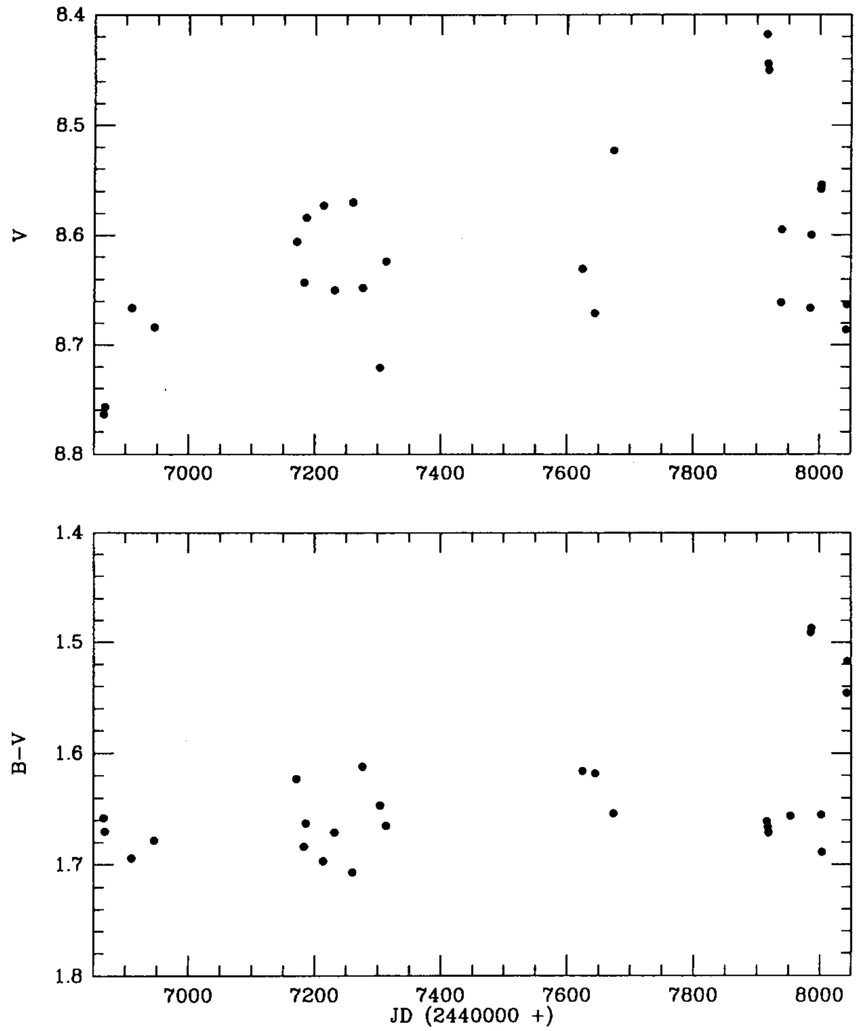


FIGURE 1: V and B-V MAGNITUDES FOR HD 97305

TABLE I

JD	V	B-V	JD	V	B-V
6865.8854	8.764	+1.658	7644.6819	8.671	+1.618
6867.8597	8.757	1.670	7673.6854	8.523	1.654
6909.7319	8.666	1.694	7915.8542	8.418	1.661
6945.6979	8.684	1.678	7916.8854	8.444	1.666
7170.8979	8.606	1.623	7917.8653	8.450	1.671
7182.9778	8.643	1.684	7938.8438	8.661	
7185.9194	8.584	1.663	7939.7942	8.595	
7212.8951	8.573	1.697	7952.7062	8.389	1.656
7230.8639	8.650	1.671	7985.7111	8.666	1.491
7259.7424	8.570	1.707	7986.7021	8.600	1.487
7275.7993	8.648	1.612	8001.7486	8.558	1.655
7303.6896	8.721	1.647	8002.6910	8.554	1.689
7312.7278	8.624	1.665	8042.6764	8.686	1.546
7624.7139	8.631	1.616	8043.6785	8.663	1.517

bluing in the last observing season. A period search utilizing the Minimum Phase Dispersion Technique of Stellingwerf (1978) over the possible range of periods 0.5 to 525 days revealed a possible periodicity at 437.64 days, though it was unconvincing when examined as a phase diagram. Therefore, at present, the variability of HD 97305 is considered to be of an unknown or irregular type. Despite its comparative brightness, no previous spectrum history could be located for HD 97305 except for the spectral type of K5 given in the HD Catalog. In view of the large magnitude range over which the star varies, it would seem that a current spectrum would be of interest.

Thanks are gratefully tendered to C. Gullixson and T. Kreidl for assistance with the Lowell Observatory telescope/photometric system.

E.M. HALBEDEL

Corralitos Observatory
P.O. Box 16314
Las Cruces, NM 88004
U.S.A.

REFERENCE

Stellingwerf, R. (1978) Astrophys. J., 224, 953.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3503

Konkoly Observatory
Budapest
8 August 1990

HU ISSN 0374 - 0676

SOME NON-VARIABLE STARS

Although optical variability of stars remains an excellent indicator of unusual conditions, the non-variability of stars that are interesting or unusual from a spectroscopic point of view is also of interest. This paper reports on the photometric monitoring of ten stars which might have been considered potentially variable from their spectra. Table I details the stars and the reason for which they were chosen for observation.

TABLE I

THE PROGRAM STARS

HD 31342	Possible variable from Halbedel (1986).
32640	Possible variable from Halbedel (1986).
37149	Helium weak Be star.
97859	Possible variable from Geneva photometry (Rufener & Bartholdi, 1982); A0.
128220	Possible variable from Geneva photometry (ibid.); sdO + G0 III.
134458	F3 V star.
135485	B5 IIp star.
157857	O7f star with x-ray emission. Possible neutron star companion.
192641	WC+B binary system.
210208	Spectroscopic binary with Hα emission (Bidelman, 1988).

Differential BV photometry was performed for each of the above stars primarily with the 0.6-m, telescope of the Corralitos

TABLE II

STAR	V, SE	B-V, SE	#	JD RANGE	COMPARISON STARS, V, B-V
HD 31342	9.057 (.025)	+.169 (.018)	14	6335-7590	HD 31380 (8.985; +.213) 32316 (8.117; +.287)
HD 32640	8.692 (.020)	+.303 (.019)	12	6331-7590	HD 33153 (9.263; +.197) 33183 (9.113; +.261)
HD 37149	8.052 (.018)	-.095 (.016)	17	6376-7234	HD 37141 (8.451; +.007) 37173 (7.862; -.073)
HD 97859	9.349 (.023)	-.081 (.022)	28	7300-8042	HD 98452 (9.233; +.265) 98631 (7.166; +.402)
HD 128220	8.471 (.016)	+.303 (.029)	19	7300-7704	HD 127667 (7.821; +.499) 128254 (8.444; +1.071)
HD 134458	8.767 (.017)	+.460 (.016)	29	6866-7326	HD 133772 (7.469; +.075) 134214 (7.473; +.354)
HD 135485	8.158 (.013)	-.058 (.018)	28	6866-7326	HD 135637 (8.036; +.282) 136276 (7.933; +.397)
HD 157857	7.777 (.014)	+.216 (.035)	6	6867-7703	HD 157499 (8.074; +.922) 158119 (9.094; +.431)
HD 192641	7.901 (.019)	+.292 (.032)	9	7313-7703	HD 192661 (6.571; +1.307) 192745 (8.177; +.025)
HD 210208	7.959 (.017)	+.072 (.022)	15	7790-7881	BD+42 4298 (8.613; +1.027) BD+42 4301 (8.563; +.738)

Observatory and its uncooled single-channel photon-counting photomultiplier which utilizes an EMI 9924A tube. Several magnitudes were also obtained with the Kitt Peak Observatory #2 0.9-m. telescope and its automated filter photometer and 1P21 tube. There was excellent consistency between the Kitt Peak and Corralitos systems: 0.003 magnitudes in Δ V & Δ B-V, a difference not considered significant. The average standard errors about the mean for the comparison stars for all the stars concerned were 0.017 and

0.020 magnitudes in V and B-V respectively. Therefore, the average external errors of the program stars may be considered to be comparable.

Table II details the mean magnitudes, comparison stars utilized, and time periods of observation for the program stars. All were considered to be non-variable over the time periods over which they were observed. Remarks on individual stars follow.

HD 31342, 32640: Although stated to be possibly variable by Halbedel in a previous paper, sustained series of observations have revealed that they are essentially constant. HD 31342, however, has a higher standard error in V than the other stars and may be microvariable at the limits of detection of the Corralitos system.

HD 97859: Photometric observations at Geneva showed a possible microvariability in V magnitude. This was not confirmed over the time period stated.

HD 128220: Found to be microvariable in V and colors at Geneva, HD 128220 was also found to be non-variable over the JD range 2447275-7328 by Hooten et al. (1989) for 88 observations over 47 nights.

E.M. HALBEDEL

Corralitos Observatory
P.O. Box 16314
Las Cruces, NM 88004
U.S.A.

REFERENCES

Bidelman, W.P. (1988) Pub. Astr. Soc. Pacific, 100, 1084.

Halbedel, E.M. (1986) IBVS No. 2919.

Hooten, J.T. et al., (1989) IAPPP Com. No. 38, 19.

Rufener, F. & Bartholdi, P. (1982) Astr. & Astrophys. Sup., 48, 503.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3504

Konkoly Observatory
Budapest
10 August 1990

HU ISSN 0374 - 0676

THE IRAS SOURCE 04430-2356 = NSV 1710 IS A MIRA STAR

Recently Klemola (1990) directed the attention to the strong variability of the infrared source IRC-20062 = IRAS 04430-2356 in the blue range. The source had been included in the NSV Catalogue (Kukarkin et al. 1982) (NSV 1710) because of the large dispersion of the IRC measurements (Neugebauer et al. 1969). As was already noted by Klemola the star is identical with a red object of the POSS. It is, however, neither identical with CoD $-24^{o}2554$ (Neugebauer et al.) nor with CoD $-24^{o}2552$ (Bidelman 1980), but is situated nearly half-way between the two - see the Figure. It should be remarked that because of their faintness CoD $-24^{o}2552$ and $-24^{o}2549$ are not depicted on the CoD chart. The (wrong) spectral type K2 given originally also results in the erroneous identification by Neugebauer, as CoD $-24^{o}2554$ = HD 30271. An obviously correct spectral type M8 comes from Hansen and Blanco (1975); it corresponds to the colour index of B-V = $2\overset{m}{.}6$ estimated by Klemola.

By examining about 300 Sonneberg blue sensitive Sky Patrol plates of the years 1952 to 1983 (centred at $5^{h}-20^{o}$) I found that this is a Mira star with a period of approximately 447^{d}. On the POSS sheets (1953 Nov. 11/12) by chance the object is at maximum, this fact is confirmed by 4 Sonneberg plates of 1953 October to December. Seven further maxima could be found in the examined material. They include the very bright one of 1964 December, when the star reached the brightness of CoD $-24^{o}2554$ ($10\overset{m}{.}3$ pg. according to HD catalogue); consequently the amplitude in the blue spectral range amounts to 7.5 mag at least, if the Lick minimum of $17\overset{m}{.}5$ - $18\overset{m}{.}0$ mentioned by Klemola is taken into account. Possibly the maximum is double-peaked (Ludendorff class γ 2, see Hoffmeister, Richter, Wenzel 1985, p.59). The data fit well into Keenan's (1966) period-spectrum relationship.

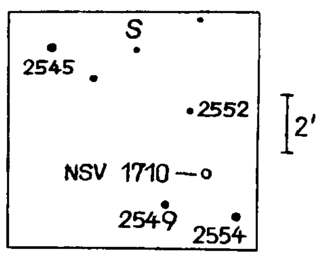


Figure 1

W. WENZEL

Sternwarte Sonneberg
Zentralinstitut für Astrophysik
Akademie der Wissenschaften der
DDR

References:

Bidelman, W.P.: 1980, Publ. Warner Swasey Obs. 2, No. 6.
Hansen, O.L., Blanco, V.M.: 1975, Astron. J., 80, 1011.
Hoffmeister, C., Richter, G., Wenzel, W.: 1985, Variable Stars, Springer-Verlag, New York
Keenan, P.C.: 1966, Astrophys. J., Suppl. Ser., 13, 333.
Klemola, A.R.: 1990, IAU Circ. 5031.
Kukarkin, B.V. et al.: 1982, New Catalogue of Suspected Variable Stars, Nauka, Moscow
Neugebauer, G. et al.: 1969, Two-Micron Sky Survey, NASA, Washington

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3505

Konkoly Observatory
Budapest
16 August 1990

HU ISSN 0374 - 0676

THE POSITION OF RZ NORMAE

RZ Nor was first studied by Gaposchkin (1952) and it is a typical R Coronae Borealis type variable star (i.e., an RCB star). Accurate positions of it as well as other southern RCB stars were published by Villada (1980); identification charts may be found elsewhere (Milone, 1990).

Unfortunately, the position as given by Villada is incorrect (I assume responsibility for the misidentification). The reason is that we had originally identified RZ Nor correctly, but an erroneous identification was passed on to us afterwards which was accepted as correct (star 1 in Fig. 1); it is actually the position of star 1 which was published by Villada.

Two plates were obtained at Córdoba with the 33-cm "Carte du Ciel" astrograph (plate scale 1 mm = 1') in 1975, June 8 (# 75016), and 1988, August 8 (# 88004) and were used here for determining the position of RZ Nor. The plates were measured with a manual Repsold machine in direct and reversed position to allow for bisection errors.

Reductions were made by the least-squares method using linear terms only, and positions and proper motion from the SAO Star Catalogue were used for eleven reference stars. As this star catalogue is on the FK4 system, so are our derived positions (note that Villada's positions are on the FK3 system).

Table I contains the measured (X,Y) coordinates for the reference stars (SAO Catalogue numbers in column 2) and for the stars of interest. As very little is known about the spatial motions of the RCB-stars, these (X,Y) values may be found useful in the future, when better positions and pm for the reference stars used here become available. An improved position for the present epoch could then be obtained for RZ Nor, and comparison with a future accurate position would allow a reliable pm determination.

Star No. 2 in Fig. 1 is a new suspected variable. Small brightness variations seem to be present on our plates. Further details will be given elsewhere.

Reductions were performed using all eleven reference stars and, alter-

TABLE I

Reference Star No.	Identification	Pl.#75016 X	Pl.#75016 Y	Pl.#88004 X	Pl.#88004 Y
1'	243858	-65.898	-41.283	-70.750	-36.923
2'	243882	-47.937	21.664	-54.328	26.412
3'	243892	-41.528	18.062	-47.831	22.987
4'	243898	-31.958	-28.957	-37.132	-23.770
5'	243935	10.651	23.562	4.149	29.774
6'	243937	10.857	13.487	4.604	19.684
7'	243942	17.114	- 3.693	11.276	2.662
8'	243956	32.175	-30.908	26.983	-24.153
9'	243971	53.816	29.007	47.180	36.266
10'	243975	57.994	-54.736	53.306	-47.433
11'	243977	61.527	20.729	55.058	28.175
	RZ Nor	1.903	6.126	- 4.152	12.106
	RZ Nor close companion	2.170	6.214	- 3.908	12.207
	Star No. 1	1.916	2.939	- 4.062	8.936
	Star No. 2	- 5.084	4.841	-11.112	10.662
	Plate center	AO=$16^h 28^m 37.13^s$		$16^h 28^m 56.87^s$	
	(1950.0)	DO=-53°12' 23.2"		-53°15' 42.7"	
	Epoch	1975.4		1988.6	

TABLE II

	R.A. (1950.0)	DEC.
RZ Nor	$16^h 28^m 45.076^s$	-53°09'11.58"
RZ Nor close companion	16 28 45.924	-53 09 08.88
Star No. 1	16 28 45.100	-53 10 46.13
Star No. 2	16 28 22.005	-53 09 49.13

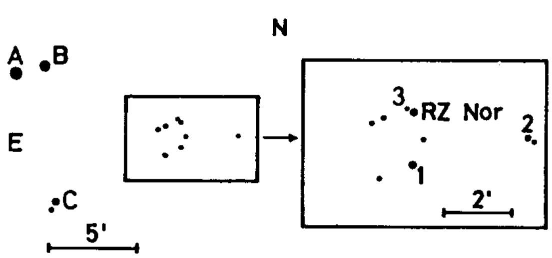


Figure 1. Some details in the region around RZ Nor are shown in this Figure. A, B and C, are SAO stars number 243947, 243945 and 243942, respectively. Star No. 1 was repeatedly confused with RZ Nor (Villada, 1980; Feast and Glass, 1973 and Glass, 1978), star No. 2 is a new suspected variable star, star No. 3 is RZ Nor close companion.

natively, employing stars No. 1', 3', 4', 6', 7', 8' and 11'. Positions derived are for the mean epoch 1982.0 and we estimate that they are accurate to +-0.4" in both coordinates (see Table II).

The separation and position angle between RZ Nor and its close companion (optical?) are:

1975.4 Rho = 8.34" , Theta = 71.8°

1988.6 Rho = 7.83" , Theta = 69.0°.

Many thanks to Mr. J.J. Rodríguez for kindly instructing me in the use of the Repsold measuring machine, to Mr. Z.M. Pereyra for making available a computer program for reducing the plate measurements which with only very minor modifications was used throughout this work, and to Mr. J.E. Laborde for preparing Fig. 1. Last but not least, many thanks to Lics. Alejandra A. E. Milone and Guillermo Torres for valuable suggestions and for improving my English. A grant from CONICOR, Córdoba, Argentina, partially supporting this research is gratefully acknowledged.

L.A. MILONE

Obs. Astronomico Univ. Nac. De Córdoba
Córdoba, Argentina

References:

Feast, M.W., Glass, I.S.: 1973, M.N.R.A.S., 161, 293.
Gaposchkin, S.: 1952, Harvard College Obs. Ann., 115, 47.
Glass, I.S.: 1978, M.N.R.A.S., 185, 23.
Milone, L.A.: 1990, Ap. and Sp. Science (in press).
Villada, M.M.: 1980, IBVS, No.1748.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3506

Konkoly Observatory
Budapest
21 August 1990

HU ISSN 0374 - 0676

HD196470 - A new equatorial rapidly oscillating Ap star

The rapidly oscillating Ap stars are cool magnetic Ap stars which exhibit low degree ($\ell \leq 3$), high overtone ($n \approx 30$) pulsations with peak-to-peak B amplitudes <16 millimagnitudes (mmag) and periods in the range of 4-15 minutes. Including HD196470, there are now 15 of these variable stars known. The amplitude of the oscillations in the roAp stars is modulated on a time-scale of days. The canonical model which explains this modulation is Kurtz's *oblique pulsator* model. In this model, a roAp star is simply a pulsating *oblique rotator* (Wolff 1983) in which the magnetic and pulsation axes coincide. Refer to the recent review by Kurtz (1990) for further details.

HD 196470 is a tenth magnitude equatorial ($\delta = -18$) star classified as Ap SrEu(Cr) by Houk (1988). As part of an ongoing search for new rapidly oscillating Ap stars, we obtained high-speed photometry of HD 196470 on the night 30 June/1 July 1990 (JD2448073). We used the University of Cape Town Photometer attached to the 1.0-m Elizabeth telescope of the South African Astronomical Observatory. All the data presented in this paper comprise continuous 10-s integrations through a Johnson B filter. A 30-arcsec diaphragm was used for all of the observations.

The data were prepared for frequency analyses in the following way: Firstly, we corrected the observations for coincidence counting losses. Next we subtracted the sky background contribution and then we removed the mean extinction. Finally, we binned the data to 40-s integrations by taking non-overlapping 4-point averages. Data reduced in this manner will always contain residual long-term trends which arise from gradual changes in sky transparency. On good nights, such sky transparency variations will be of sufficiently low amplitude and will also be slow enough to not interfere with our search for rapid oscillations. We do not use comparison stars and thus we do not transform our data to the standard system.

A visual inspection of the real-time display of the observations of HD 196470 on the night JD2448073 suggested the presence of oscillations with a period of 10.8 min. and an amplitude of around 0.8 mmag. However, as it was not an excellent night, we could not exclude the possibility that this was just an effect of sky transparency variations. We present in Fig. 1 (top panel) an amplitude spectrum of these data out to the Nyquist frequency of 12.5 mHz for 40-s integrations. The amplitude spectra presented in this paper were computed using Kurtz's (1985) faster implementation of Deeming's (1975) Discrete Fourier Transform algorithm for unequally spaced data. The peak marked

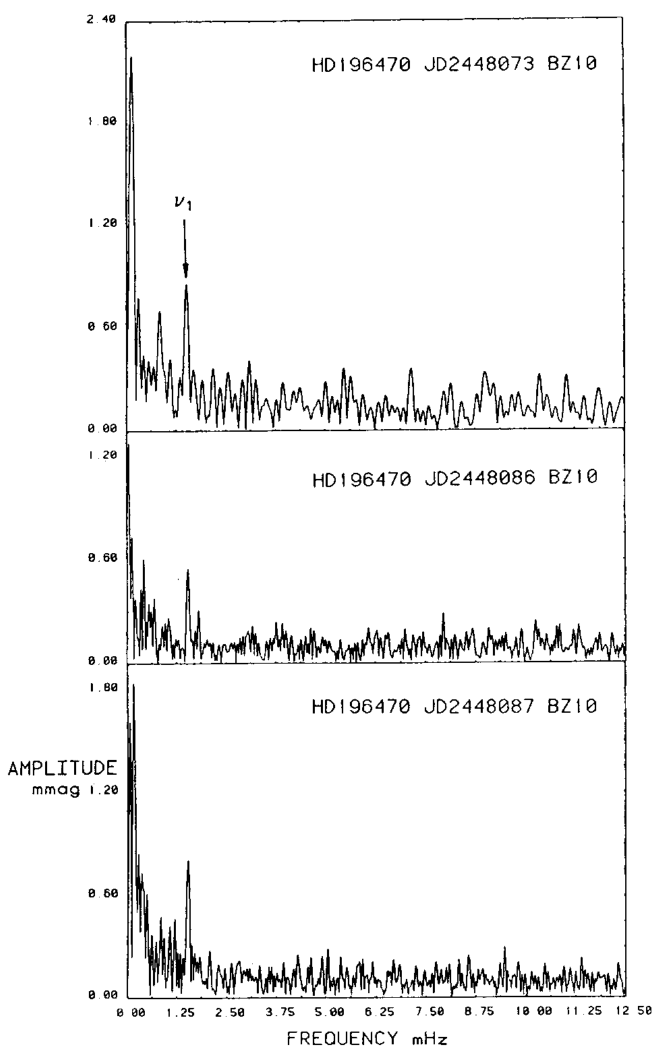


Figure 1

ν_1 at 1.54 mHz is hardly convincing in the presence of the sky transparency variations on that night, so we elected to confirm the reality of these oscillations by observing HD 196470 again on the nights 13/14 and 14/15 July 1990 (JD2448086-8087). The amplitude spectra for these two nights are presented in the middle and lower panels of Fig. 1, respectively. These amplitude spectra reveal that the sky transparency variations were less of a problem on the last two nights and ν_1 can be seen clearly.

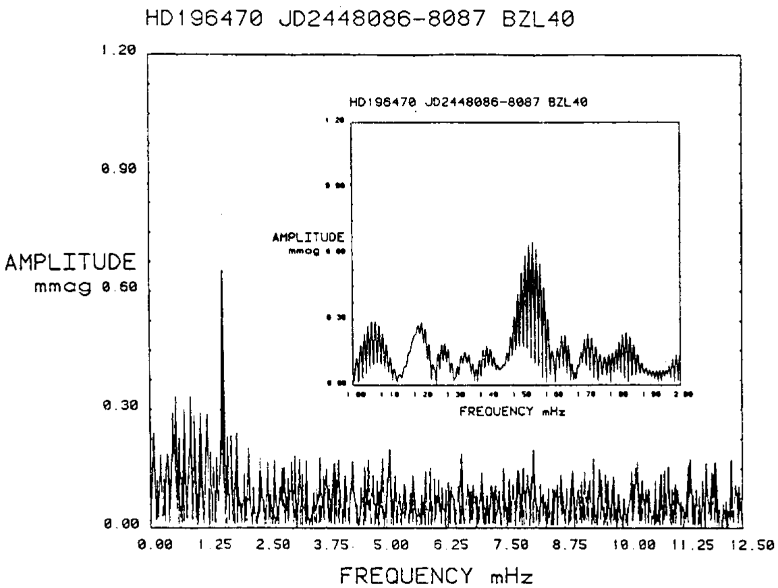


Figure 2

For an oblique pulsator, rotational amplitude modulation gives rise to a $(2\ell+1)$ multiplet in the amplitude spectrum with a spacing equal to the rotation frequency of the star. Thus the discovery of such rotational sidelobes would reveal the rotation period of HD196470 and would also allow us to constrain the magnetic obliquity and rotational inclination of this star. There is an indication of modulation in the amplitude of ν_1 in Fig. 1, but the reader should exercise caution here because the difference in amplitude from night to night could easily arise from the interaction of ν_1 with noise peaks suitably related in phase to ν_1 or with other unresolved oscillation modes in the star.

In Fig. 2 we present an amplitude spectrum for the nights JD 2448086-8087. The prominent peak is at $\nu_1 = 1.544$ mHz. In this amplitude spectrum we have removed the peaks at low frequency which we attribute to sky transparency variations. The inset shows the same spectrum in the frequency range 1 - 2 mHz; the severe 1 day^{-1} alias problem evident in the inset is not surprising. We also analyzed all three nights together. In both cases, we selected the tallest peak in the vicinity of ν_1 and optimized its amplitude and phase by fitting it to the data with a least squares algorithm. We then removed sinusoids from the data with these optimized amplitudes and phases and found no convincing evidence for further frequencies.

For completeness, we present in Fig. 3 a sample lightcurve of observations obtained on the night JD2448087. The sky transparency variations have been removed from these data. The solid line

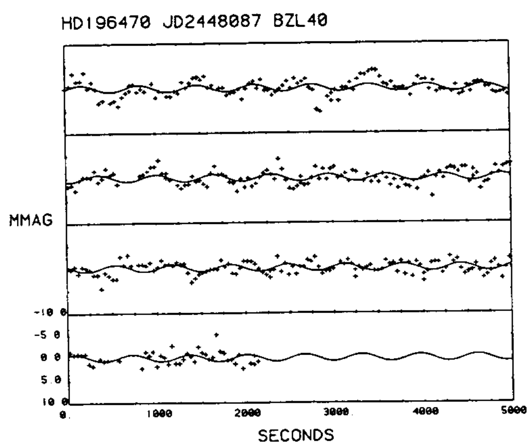


Figure 3

is a fit of a sinusoid of frequency $\nu_1 = 1.544$ mHz with its amplitude and phase determined by least squares. The fit to the observations is reasonably good.

As Fig. 1 shows, the noise at ν_1 is not always scintillation limited. This, plus the fact that the oscillations are of low amplitude, means that this star will be difficult to study; observations with large aperture telescopes on excellent nights will be required in order to reduce the scintillation noise to allow the search for secondary frequencies and rotational sidelobes.

PETER MARTINEZ, D.W. KURTZ, G. KAUFFMANN, A.C. JONSON

Dept. of Astronomy

University of Cape Town

Rondebosch, 7700

South Africa

References

Deeming, T.J., 1975. *Astrophys. Space Sci.*, **36**, 137.

Houk, N & Smith-Moore, M., 1988. Michigan Spectral Catalogue of Two-Dimensional Spectral Types for the HD Stars Volume 4, Dept of Astronomy, University of Michigan.

Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213**, 773.

Kurtz, D.W., 1990. *Annual Reviews of Astronomy & Astrophysics*, **28**, 607.

Wolff, S.C., 1983. *The A-Type Stars: Problems and Perspectives*, NASA Special Publication 463.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3507

Konkoly Observatory
Budapest
21 August 1990

HU ISSN 0374 - 0676

THE DISCOVERY OF RAPID OSCILLATIONS IN THE Ap STAR HD161459.

The cool Ap star HD161459 was monitored photometrically for 7.36 hr on the night 16/17 July 1990 (JD2448089), as part of an ongoing program to detect rapid oscillations among the chemically peculiar A stars. The photometry, which consists of a series of continuous 10-s integrations, was obtained with the University of Cape Town photometer attached to the 1.0-m Elizabeth telescope of the South African Astronomical Observatory (SAAO). All the observations were obtained using a Johnson *B* filter and a 30-arcsec diaphragm with occasional interruptions for sky measurements. Because we were searching for oscillations with periods in the range of 4 to 15-minutes, we did not

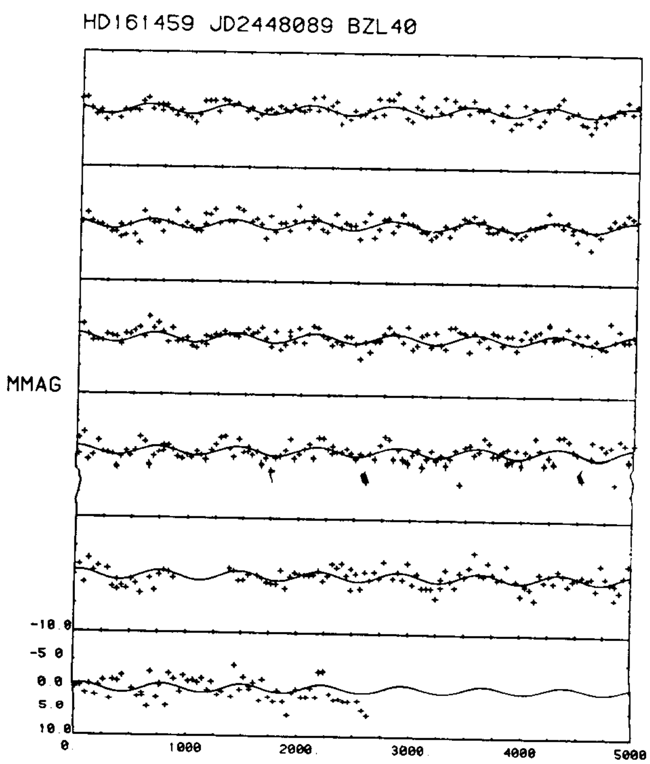


Figure 1

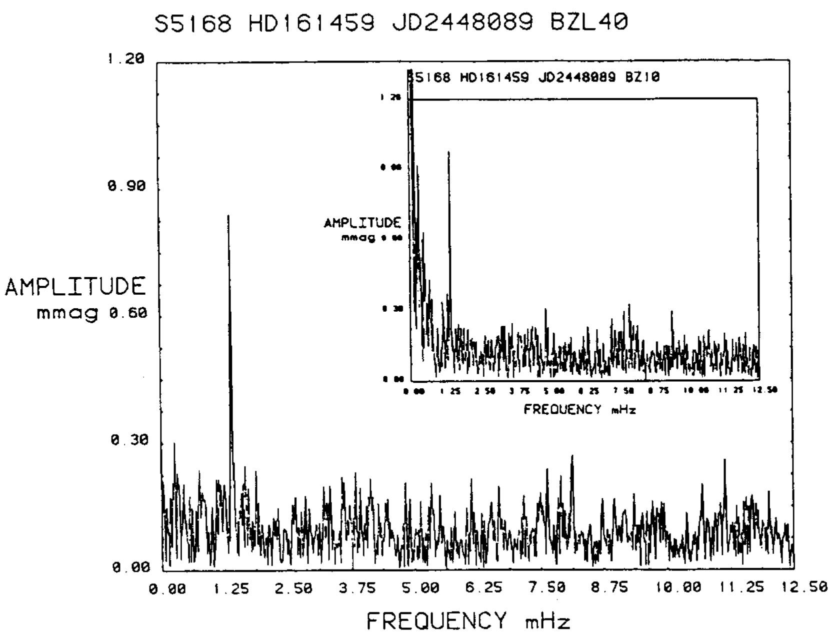


Figure 2

employ a comparison star. However, experience has shown that on good nights it is usually possible to distinguish between slow changes in sky transparency and rapid oscillations in the star. The data were corrected for coincidence counting losses, sky background and mean extinction, in that order. Finally we took non-overlapping four-point averages of the data. We also removed some long-period ($P > 0.92$ hr, $\nu < 26$ day^{-1}) variations which we attribute to the slow changes in sky transparency mentioned above. Since the periods of such variations are well removed from the periods of interest, their removal does not affect the analysis of these data. The resulting light curve is presented in Fig. 1.

Figure 2 is an amplitude spectrum of the data in Figure 1 out to the Nyquist frequency of 12.5 mHz for 40-s integrations. This amplitude spectrum was computed using Kurtz's (1985) faster implementation of Deeming's (1975) Discrete Fourier Transform algorithm for unequally spaced data. The prominent peak is at $\nu = 1.39$ mHz ($P = 12.0$ min.) with a semi-amplitude of 0.84 millimagnitudes. The inset in Fig. 2 shows that we have a convincing detection of the rapid oscillations even in the presence of the sky transparency variations. These variations raise the level of the noise dramatically at lower frequencies.

A sinusoid with the frequency $\nu = 1.39$ mHz has been fitted to the data by least squares in order to optimize its amplitude and phase. This sinusoid is shown as the solid curve in Fig 1. The fitted curve is in fairly good agreement with the observations.

The discovery of rapid oscillations in HD161459 brings to 16 the total number of rapidly oscillating Ap stars known (Kurtz 1990, Martinez *et al.* 1990). Further high-speed photometry of this object will be acquired in the near future.

PETER MARTINEZ
G. KAUFFMANN
Dept. of Astronomy
University of Cape Town
Rondebosch, 7700
South Africa

References

Deeming, T.J., 1975. *Astrophys. Space Sci.*, **36**, 137.

Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213**, 773.

Kurtz, D.W., 1990. *Annual Reviews of Astronomy & Astrophysics*, **28**, 607.

Martinez, P., Kurtz, D.W., Kauffmann, G. & Jonson, A.C., 1990., *Inf. Bull. Var. Stars No.* 3506.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3508

Konkoly Observatory
Budapest
21 August 1990

HU ISSN 0374 - 0676

THE ULTRAVIOLET SPECTRUM OF CLOSE BINARY STAR V448 CYGNI

The ultraviolet spectrum of V448 Cygni was obtained on July 25, 1982, using the IUE SWP 1746 camera in the range from 1165 Å to 2126 Å, with the resolution ~6 Å (see Fig.1) at the phase of orbital period $0^P.74$. Because of low resolution, the spectra of primary and secondary components were not separated, despite in optics it is possible at this phase (Glazunova, 1987).

For comparison with the models of Kurucz (1979), the interstellar absorption was taken into account by using the known dependence of X_λ from $E(\lambda-V)/E(B-V)$ relationship (Nandy et al.,1975), where the value of color excess $E(B-V)= 0^m.67$ for V448 Cygni was used (Hiltner,1956). The main parameters of the model of Kurucz were derived by Glazunova (1987): T_{eff}=20000 K, lg g = 3 for the primary; and T_{eff}=30 000 K, lg g = 4 for the secondary,respectively. Continuum fluxes, obtained by using the programs of Kurucz (1979) in LTE-approximation, were summarized for both components. The parameters of components obtained in the optical range are describing the binary system's UV-spectrum rather well (Fig. 2).

The identification of the absorption lines was made by comparing with the synthetic spectrum (Kurucz, 1979). The strong resonance lines such as Ly_α, CIV 1550, SiIV 1394-1403, and strong lines CII 1335, SiIII 1206, SiIII 1298-1304, NIV 1718, as well as a set of Fe lines, in various ionization stages were identified. From Howarth and Raman(1989), one may

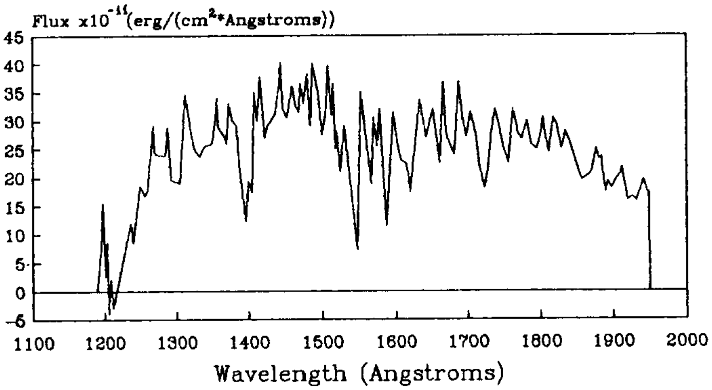


Figure 1

— Flux x10^-11(erg/cm^2*A)

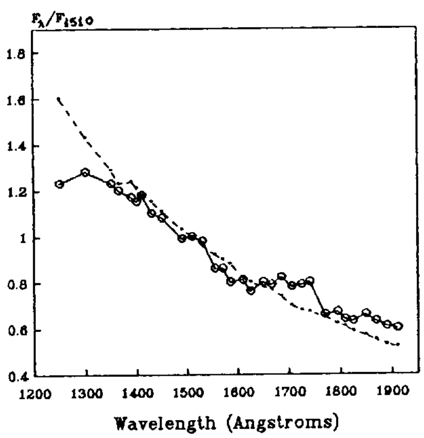


Figure 2

--- Ftheor/F1510 —o— Fobs/F1510

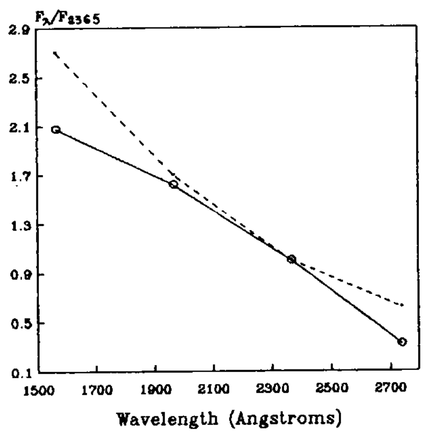


Figure 3

--- Ftheor/F2365 —o— Fobs/F2365

obtain the mass loss rate in lines of these ions

Ion	$\dot{M}$ ($M_{\odot}$ / yr)
C^{3+}	$10^{-9.9\pm0.5}$
N^{4+}	$10^{-9.6\pm0.5}$
Si^{3+}	$10^{-9.3\pm0.5}$

The total mass loss rate by stellar wind for V448 Cygni is $\sim 10^{-7.1 \pm 0.5}$ $M_{\odot}/yr$.

Besides that, we studied the data for some absolute fluxes in the UV range for V448 Cygni measured in 1978 by the Sky Survey Telescope aboard the ESRO satellite TD-1 (Catalogue of Stellar Ultraviolet Fluxes, 1978).

Wavelength ,Å	2740	2365	1965	1565
Flux , $E \cdot 10^{-12}$ erg/(cm^2·s·Å)	2.63	2.24	3.62	3.61
E r r o r, $E \cdot 10^{-12}$erg/(cm^2·s·Å)	0.26	0.41	0.69	0.41

In Fig.3 one may compare the UV-fluxes (corrected for the interstellar absorption), from TD-1, with the models of Kurucz. Empirical and theoretical energy distributions in the spectrum of V448 Cygni are normalized to the flux at λ2365. One may see the depressions of the continuum from 1565 Å to 1965 Å and from 2400 Å to 2800 Å. The range of λλ2400-2800 Å was used to estimate the circumstellar envelope parameters while assuming the outstanding additional absorption in numerous UV-lines. The mean depression value was $\bar{D}=0^m.307$, and the parameters of two envelope models computed by Jafarli and Lyubimkov (1988), are:

a) $T_s = 10^4$ K, $Ne = 10^{12}$ cm^{-3} , $R_s = 1.23 \cdot R_*$;

b) $T_s = 10^4$ K, $Ne = 10^{11}$ cm^{-3} , $R_s = 30 \cdot R_*$.

GALINA V. VOLKOVA

Astronomical Obs.
Odessa State Univ.
Odessa, USSR.

References:

Catalogue of Stellar Ultraviolet Fluxes, 1978 / A compilation of absolute stellar fluxes measured by the Sky Survey Telescope (S2/68) aboard the ESRO satellite TD-1 /.
Glazunova, L.V.: 1987, PhD Thesis, Odessa State University.
Hiltner, W.A.: 1956, Astrophys. J. Suppl. Ser. 2, 24, 389.
Howarth, I., Prinja Raman, K.: 1989, Astrophys. J. Suppl. Ser. 69, 3, 527.
Jafarli, A., Lyubimkov, L.: 1988, Izvestiya KrAO, 80, 18.
Kurucz, R.L.: 1979, Astrophys. J. Suppl. Ser. 40, 1.
Nandy, K., Thomson, G.I., Jamar, C., Monfils, A., Wilson, R.: 1975, Astron. Astrophys. 44, 195.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3509

Konkoly Observatory
Budapest
27 August 1990
HU ISSN 0374 - 0676

TWO NEW SOUTHERN RAPIDLY OSCILLATING Ap STARS - HD 193756 & HD 218495.

The rapidly oscillating Ap (roAp) stars are cool magnetic Ap stars with Sr, Cr and Eu line strength anomalies which pulsate in low degree ($\ell \leq 3$), high overtone ($n >> \ell$) p-modes. The periods of pulsation range from 4-15 min and the Johnson B peak-to-peak pulsation amplitudes are all ≤ 16 mmag. The most comprehensive recent review of these stars is that of Kurtz (1990).

As part of a survey of the roAp phenomenon in the southern skies we searched for and discovered rapid oscillations in the stars HD 193756 and HD 218495. We used the University of Cape Town Photometer attached to the 1.0-m Elizabeth telescope of the South African Astronomical Observatory. The observations consist of continuous 10-s integrations through a Johnson B filter and a 30-arcsec aperture. After removing the bad points from the data, we corrected the data for coincidence counting losses, subtracted the sky contribution and corrected for mean extinction. We then removed some long-term ($P \geq 0.5$hr) trends from the data which almost certainly arose from sky transparency variations. Finally we binned the data to 40-s integrations and computed amplitude spectra using Kurtz's (1985) implementation of Deeming's (1975) Discrete Fourier Transform out to 12.5 mHz, the Nyquist frequency for 40-s integrations.

HD 193756

We accumulated 12.45 hr of high-speed photometry of this star over the 5 widely spaced nights JD2448072, 8074, 8104, 8105 & 8110. In Figure 1 we present an amplitude spectrum of the entire data set which reveals the presence of oscillations at $\nu = 1.284$ mHz. There are reasonably convincing indications of amplitude modulation in the amplitude spectra of the nightly data sets. Such modulation can arise through beating of unresolved modes, through changing aspect as the star rotates, through intrinsic variations in the pulsation amplitude or, indeed, through all of these effects operating together. Further observations will be required to enable us to discriminate among these possibilities.

HD 218495

We acquired 7.39 hr of high-speed photometric observations of this star on the nights JD2448104, 8107 and 8110. The amplitude spectrum presented in Figure 2 reveals the presence of oscillations with a frequency $\nu = 2.24$ mHz.

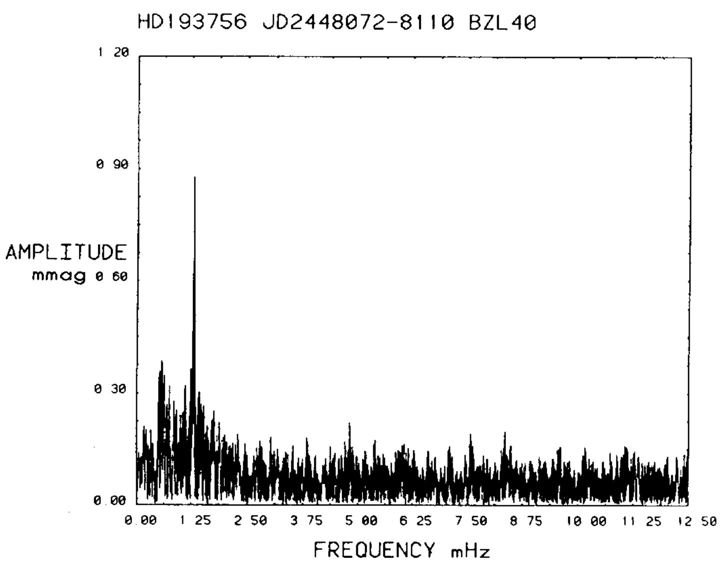


Figure 1

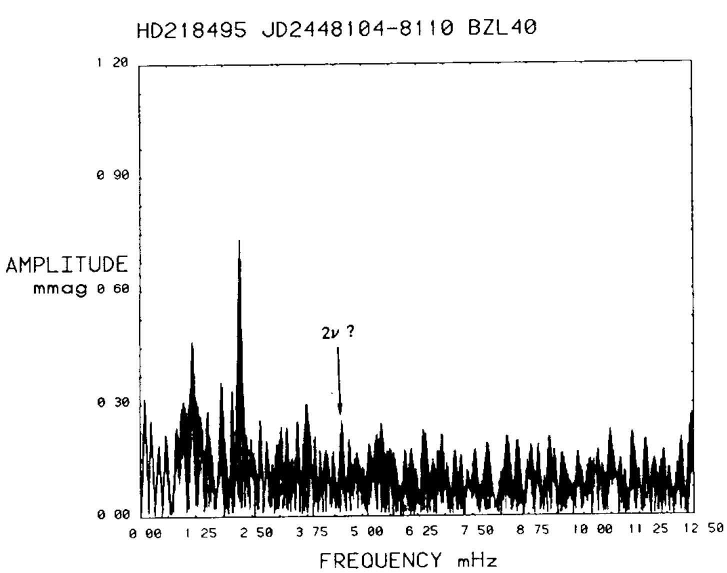


Figure 2

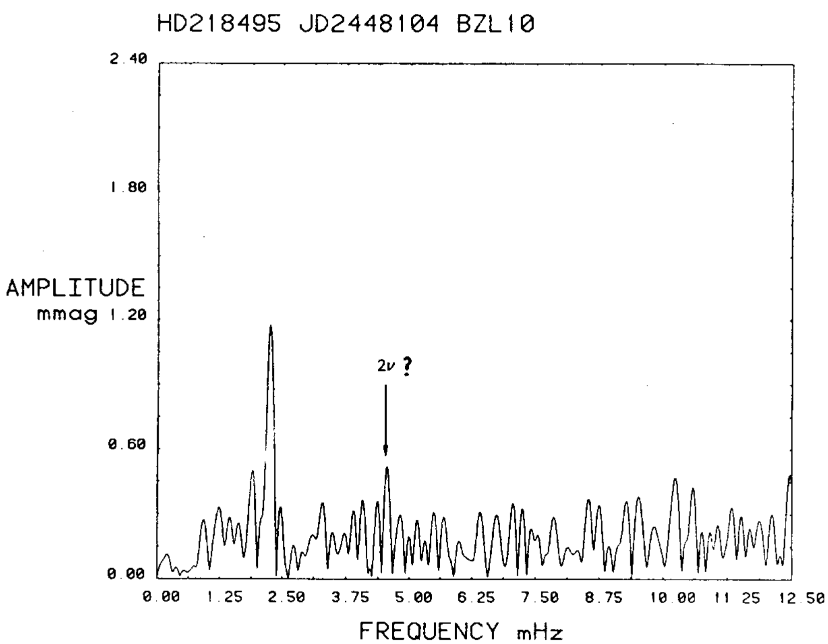


Figure 3

The peak at 4.5 mHz labeled "2ν?" in Fig. 2 is intriguing because, if real, it lies exactly where one would expect to find the first harmonic of the principal pulsation frequency ν. Such harmonics are observed in 5 other roAp stars. We also searched for this peak in the nightly data sets in order to test for the possibility that only one of the light curves might be dominating the analysis when all nights are analysed together. The peak at 2ν shows up fairly well in the JD2448104 data (Figure 3) and a peak appears at the *same* frequency on the other two nights but at such reduced amplitude that it does not draw attention to itself. This is not surprising given the lower amplitude of ν on those nights and the lower signal to noise which obtains in this higher frequency regime. The fact that the peak at 2ν persists if we Fourier analyse all 3 nights together argues for phase coherence of the conjectured harmonic across the different nightly data sets.

PETER MARTINEZ and D.W. KURTZ

Dept. of Astronomy, Univ. of Cape Town
Rondebosch, 7700 South Africa

References

Deeming, T.J., 1975. *Astrophys. Space Sci.*, **36,** 137.

Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213,** 773.

Kurtz, D.W., 1990. *Annual Reviews of Astronomy & Astrophysics*, **28,** 607.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3510

Konkoly Observatory
Budapest
27 August 1990
HU ISSN 0374 - 0676

HD 190290 - ASTEROSEISMOLOGY IN ONE NIGHT

The Southern (δ = -79°) 10th mag star HD 190290 classified as Ap EuSr by Houk & Cowley (1975) was recently placed on our program to search for rapid oscillations in cool southern Ap stars. On the night of 4/5 August 1990 (JD 2448108) we observed this star photometrically for 8.85 hr in high-speed mode with the University of Cape Town Photometer attached to the 1.0-m Elizabeth telescope of the South African Astronomical Observatory (SAAO). We acquired continuous 10-s integrations through a Johnson *B* filter and a 30-arcsec aperture. The data were corrected for coincidence counting losses, sky background, mean extinction and some long period trends which almost certainly arose from sky transparency variations. We then binned the data to 40-s integrations and computed an amplitude spectrum using Kurtz's (1985) recursive coding of Deeming's (1975) widely used Discrete Fourier Transform for unequally spaced data.

In Figure 1 (a) we present the amplitude spectrum of these observations out to the Nyquist frequency of 12.5 mHz for 40-s integrations. We include the sky transparency variations in Fig. 1(a) so that the reader may form a value judgement of the data. The photometric quality of that night was excellent; one must bear in mind that the lowest airmass attained by this δ = -79° star at SAAO is 1.4.

The prominent peak in Fig 1(a) is at ν_1 = 2.27 mHz with an amplitude 1.13 mmag. In order to test for further frequencies in the data we subtracted a sinusoid of frequency ν_1 from the data. The resulting amplitude spectrum in Fig. 1(b) clearly indicates the presence of another frequency at ν_2 = 2.23 mHz with an amplitude of 0.55 mmag. On prewhitening both ν_1 and ν_2 from the data, we are left with the spectrum shown in Fig. 1(c) which suggests the presence of further frequencies but we cannot meaningfully pursue the identification of further frequencies with these data.

The frequency separation between ν_1 and ν_2 is 40 μHz. This cannot be a rotation frequency because it would correspond to a rotation period of 6.9 hr, improbably short for an A star. We thus interpret this spacing as a crude measurement of the asymptotic *p*-mode spacing in HD 190290 consistent with values observed in other roAp stars. Of course, a thorough frequency analysis is required in order to refine our frequency determinations and to find the other frequencies which probably exist in this star.

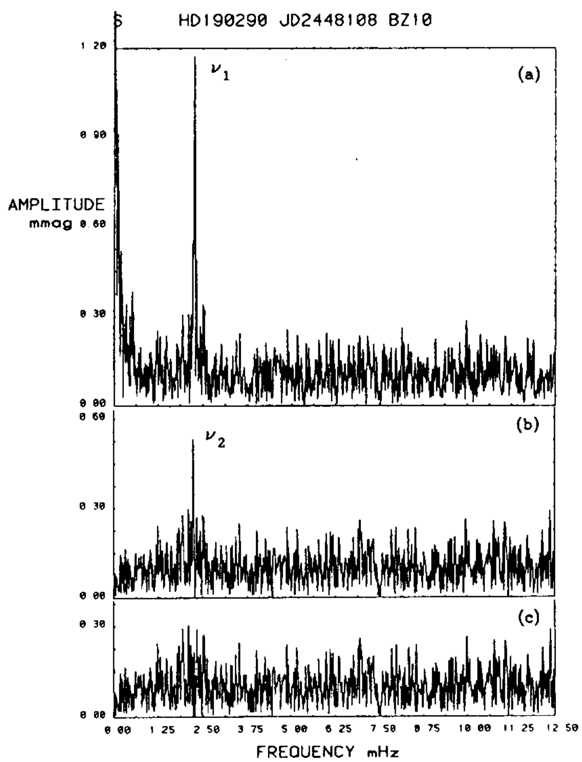


Figure 1

PETER MARTINEZ

D. W. KURTZ

Dept. of Astronomy

University of Cape Town

Rondebosch, 7700

South Africa

References

Houk, N & Cowley, A.P., 1975. *Michigan Spectral Catalogue of Two-Dimensional Spectral Types for the HD Stars Volume 1*, Dept of Astronomy, University of Michigan.

Deeming, T.J., 1975. *Astrophys. Space Sci.*, **36**, 137.

Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213**, 773.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3511

Konkoly Observatory
Budapest
31 August 1990
HU ISSN 0374 - 0676

Unexplained light variations of the F0 V star 9 Aurigae

In this paper we discuss photometry of 9 Aur that can be found in IAU file 218 of unpublished photometry of variable stars (Breger *et al.*1990). This file contains 85 broad-band differential V magnitudes and 6 Δ(B-V) colors of 9 Aur, using BS 1668 (V = 5.68, B-V = 0.42) as comparison star, obtained on 19 nights by Krisciunas, primarily at the 2800-m level of Mauna Kea on the Island of Hawaii, using a 15-cm reflecting telescope, photometer, DC amplifier, and strip chart recorder. File 218 contains 65 ΔU, 66 ΔB, and 66 ΔV observations by Guinan, obtained with a 25-cm automatic photoelectric telescope (APT) on 52 nights at Mt. Hopkins, Arizona. The APT data are differential magnitudes of 9 Aur vs. BS 1561, with the check star being BS 1568 (V = 4.47). Each APT differential magnitude represents three 10 second digital integrations: 1) on the star in question; 2) on the comparison star; and 3) on the sky. The APT data are inherently more accurate than Krisciunas' data.

Other data in File 218 relevant to this paper are measurements of α Aur (Capella) vs. 9 Aur, obtained before 9 Aur was suspected to be variable; also, infrared photometry of 9 Aur and two other F0 V stars (through broad-band filters JHKLL' and narrow-band M; λ = 1.25 to 4.67 μm).

9 Aur has been used as the comparison star for photometry of α Aur (Krisciunas 1984). Subsequent photometry of January 1987 to November 1988 by Krisciunas, when analyzed with the Discrete Fourier Transform algorithm of Deeming (1975, 1976), indicates a period of 39.4 days and an amplitude of $\Delta V \approx 0.08$ mag (Fig. 1). Guinan found no such *regular* variations for α Aur vs. BS 1668 at that time, so we naturally suspected that 9 Aur is variable.

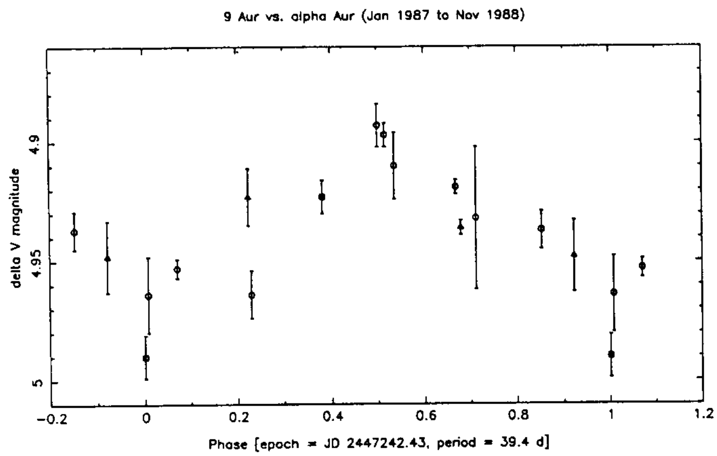


Fig. 1 ΔV differential magnitudes of 9 Aur vs. α Aur, folded with a period of 39.4 days. Triangles: data of January to March 1987. Circles: data of October 1987 to March 1988. Squares: data of September and November 1988.

Fig. 2 shows data of 9 Aur from September 1988 to April 1990, using BS 1668 as the comparison star. Data from two nights have been excluded: 17 Feb 1989 UT, when the data were reduced from ammeter readings rather than strip chart tracings; and 23 Apr 1989, when only one ΔV was obtained

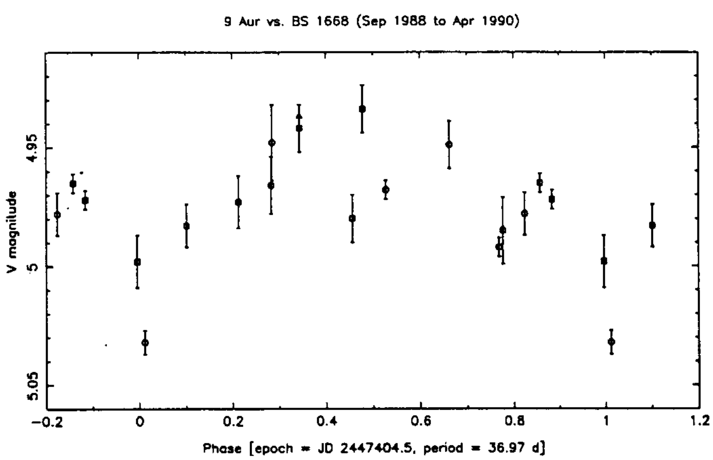


Fig. 2 V magnitude of 9 Aur, using BS 1668 as comparison star. Circles: data of September 1988 to March 1989. Squares: data of September 1989 to April 1990. Triangle: data of 12 Feb 1990 (average of first and third measurements only - second, anomalous (?) datum of V = 4.828 has been excluded from nightly mean.)

before fog and rain occurred. The wave evident in Fig. 2 results from having folded the data with a period of 36.97 days, derived from Deeming's DFT algorithm.

Guinan's data of 9 Aur vs. BS 1561 (12 Nov 1989 to 28 Mar 1990 UT) show a definite wave in the U, B, and V bands from Julian Dates 2447896 to 926 (Fig. 3). The B-band data, in particular, show evidence for a wave preceding and following these dates. Deeming's DFT algorithm gives frequency components of 34.3, 35.8, and 36.5 days for the U, B, and V data, respectively. There are other peaks in the power spectrum, but the points folded with other periods give graphs that look like scattergrams. It should be noted that APT observations of BS 1568 vs. BS 1561 show a scatter consistently half as large, with no suspected periodicity, compared to the 9 Aur vs. BS 1561 data.

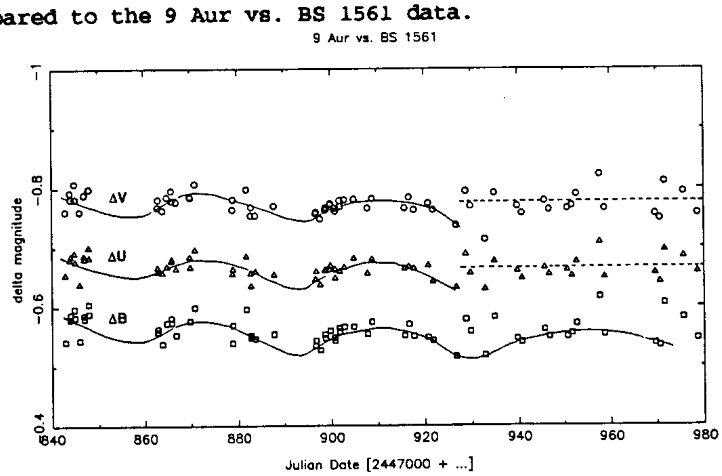


Fig. 3 Differential UBV photometry of 9 Aur vs. BS 1561, from Mt. Hopkins "Phoenix-10" telescope (November 1989 to March 1990).

The 9 Aur data (using α Aur, BS 1668, and BS 1561 as comparison stars) allow us to state that 9 Aur can exhibit sinusoidal variations with a period of 36 to 39 days.

9 Aur (= BS 1637 = Gliese 187.2) has a spectral type of F0 V (Hoffleit and Jaschek 1982) or F1 IV/IV-V (Gray and Garrison (1989). Abt (1965) found it to be a single line spectroscopic binary, but a subsequent paper by Abt and Levy (1974) "did not confirm the previous orbit," concluding that 9 Aur has a constant radial velocity and is a single star. However, if we believe the errors of the radial velocities of Abt and Levy (1974), as well as data of Takeda (1984), there are radial velocity variations of 5 or 6 km/sec. From

speckle data, Hartkopf and McAlister (1984) found no evidence for a close companion at the 0.030 arcsec level. (9 Aur does have a 12th magnitude companion 5 arcsec away, and a V = 9.43 red companion 90 arcsec away, according to Gliese's *Catalogue of Nearby Stars* (1969).) We summarize some of the observational characteristics of 9 Aur in Table I.

Table I

Some Observed Properties of 9 Aur

Spectral type: F0 V or F1 IV/IV-V

$\langle V \rangle = +4.98$	$(b-y) = +0.217$
$B-V = +0.34$	$m_1 = +0.152$
$U-B = +0.04$	$c_1 = +0.642$
	$\beta = 2.723$

$M_V = +3.4$ (Gliese 1969)
$= +2.94$ (from $c_1 - (b-y)$)

v sin i = 14 km/sec (upper limit?)

$V_{rad} = -2.1 \pm 0.5$ to 3.4 ± 0.7 km/sec

Light Amplitude (ΔV) $\approx$ 0.04 to 0.08

Period $\approx$ 36-39 days (and < 1 hour?)

What could be the cause of the light variations of 9 Aur? Below we make some suggestions, in order of *increasing* likelihood.

1) A low mass companion in a highly eccentric orbit causes tidal distortions of 9 Aur.

2) A lumpy ring of dust orbits 9 Aur at the distance required for a 36-39 day orbit, causing prolonged eclipses (somewhat like ε Aur). That orbit size would be about 0.3 AU, and the dust would be heated to about 800 °K. If this were the case, we might measure an infrared excess at $\lambda \approx 4$ µm. To test this we carried out infrared photometry of 9 Aur and two other F0 V stars (BS 1869 and BS 2228) with the United Kingdom Infrared Telescope on 25 Aug and 6 Sep 1989 UT. (Beam sizes of 7.8 and 5.0 arc seconds were used in order to

keep all *known* companions of 9 Aur out of the beam.) Because simple black body curves can fit the data, there is no evidence for an infrared excess in any of the three stars.

3) Could 9 Aur be a spotted star? If so, we might expect variations with a period comparable to the rotational period of the star. According to *The Bright Star Catalogue*, 9 Aur has a rotational rate of v sin i = 14 km/sec. If it is indeed an F0 V star, then its *maximum* rotational period (letting $i = 90°$) would be 4.9 days (assuming log (R/R_{Sun}) = +0.13, given by Allen (1973, p. 209)). The 36-39 day variations tend to rule out the standard spotted star model, *if* the v sin i value is correct. However, the value of 14 km/sec originates in the list of measures of Huang (1953, wherein 9 Aur = PGC 1202), and may only be an upper limit.

4) In Fig. 4 we show Krisciunas' V-band data from four nights (4 Sep 1989 to 9 Nov 1989 UT), folded with a period of 33.8 *minutes*. (10 measurements obtained on 5 Dec 1989 UT over 50 minutes indicate a somewhat longer period.) Given the spectral type of 9 Aur, the evidence for photometric variations on time scales of tens of minutes, and the small observed variations of the radial velocity of the star, it could be that 9 Aur is a δ Sct star (i.e. short-period pulsator). While δ Sct stars can have multiple periods, there are no δ Sct stars with periods like 36-39 days. We note that 9 Aur is outside the right hand edge of the instability strip in the color-magnitude diagram (Breger 1979).

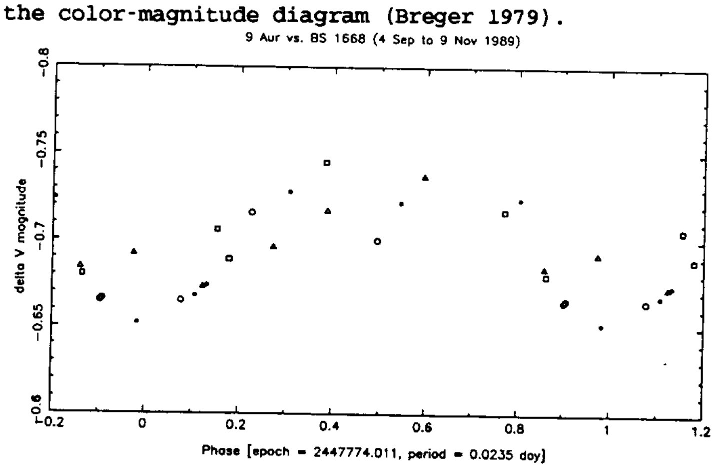


Fig. 4 ΔV data of 4 Sep 1989 UT (open circles), 12 Sep 1989 (squares), 21 Sep 1989 (triangles) and 9 Nov 1989 (dots), folded with a period of 0.0235 days = 33.8 minutes.

5) Provost and van't Veer-Menneret (1969) state: "The most striking result of [our] study is the strong microturbulence velocity, similar to that of an Am star, found in 9 Aur whose F0 m[ain] s[equence] type is well confirmed by this study." We suggest that this microturbulence could manifest itself, in an observational sense, in variations of luminosity, with or without star spots. Short-term variations could be explained by non-radial oscillations, such as those discovered in α^2 CVn stars (Wolff 1983).

Regarding stars of similar spectral characteristics, Conti and Strom (1968) list three 8th magnitude stars in the Pleiades (HD 23194, 23607, and 23924), of spectral type (A5 to A7 V) similar to 9 Aur, which have high microturbulence velocities. Breger (1972) found HD 23607 (= TR 390) to be a δ Sct star with period ≈ 0.049 day and amplitude 0.01 mag. He found the other two stars to be constant. Further photometry on HD 23607 is reported by Seeds and Stephens (1977). It is not known if any of Conti and Strom's three stars show longer-term (≈ 40 day) variability.

We need several hours of continuous data on 9 Aur with an APT or two-channel photometer (on one or more nights) to confirm if it has short-term variations like a δ Sct star. The rotational rate of 9 Aur should be remeasured. Stars of similar spectral type with high microturbulence velocities should be checked for short-term (≈ 1 hour) *and* longer-term (≈ 40 day) photometric variability.

This paper is based in part on information from the SIMBAD data retrieval system, data base of the Strasbourg, France, Astronomical Data Center. We thank Louis Boyd and Russ Genet for the use of the Phoenix-10 APT and also thank Mike Seeds of the APT Service for processing the APT data. The APT observations were supported in part by National Science Foundation grant AST-8616362, which we gratefully acknowledge. The near-infrared data were obtained as part of the UKIRT Service Observing Program. We thank D. Soderblom and W. Bidelman for useful comments and references.

K. KRISCIUNAS
Joint Astronomy Centre
665 Komohana Street
Hilo, Hawaii 96720 USA

E. GUINAN
Villanova University
Department of Astronomy
Villanova, PA 19085 USA

References:

Abt, H. A. 1965, *Ap. J. Suppl.* **11**, 429.
Abt, H. A., and Levy, S. G. 1974, *Ap. J.* **188**, 291.
Allen, C. W. 1973, *Astrophysical Quantities*, 3rd ed. (London: Athlone).
Breger, M. 1972, *Ap. J.* **176**, 367.
Breger, M. 1979, *Publ. Astr. Soc. Pacific* **91**, 5.
Breger, M., Jaschek, C., and Dubois, P. 1990, IBVS 3422.
Conti, P. S., and Strom, S. E. 1968, *Ap. J.* **152**, 483.
Deeming, T. J. 1975, *Ap. and Space Sci.* **36**, 137.
1976, *ibid.* **42**, 257 (errata to above).
Gliese, W. 1969, *Veroeffentlichungen des Astron. Rechen-Inst.* No. 22.
Gray, R. O., and Garrison, R. F. 1989, *Ap. J. Suppl.* **69**, 301.
Hartkopf, W. I., and McAlister, H. A. 1984, *Publ. Astr. Soc. Pacific* **96**, 105.
Hoffleit, D., and Jaschek, C. 1982, *The Bright Star Catalogue*, 4th ed. (New Haven: Yale Univ. Obs).
Huang, S.-S. 1953, *Ap. J.* **118**, 285.
Krisciunas, K. 1984, IBVS 2538.
Provòst, J., and van't Veer-Menneret, C. 1969, *Astron. and Astrophys.* **2**, 218.
Seeds, M. A., and Stephens, C. J. 1977, IBVS 1273.
Takeda, T. 1984, *Publ. Astr. Soc. Japan* **36**, 149.
Wolff, S. 1983, *The A-Stars: Problems and Perspectives*, (Washington, D. C.: NASA) NASA SP-463.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3512

Konkoly Observatory
Budapest
31 August 1990
HU ISSN 0374 - 0676

V759 CENTAURI: NEW TIMES OF MINIMA AND REVISED PERIOD

The binary system V759 Cen (HD 123732) was discovered by Bond (1970) on objective prism plates and confirmed by y-Strömgren photometric observations. Sisteró and Castore de Sisteró (1976) published the period P = $0^d.3939513$ determined from UBV photoelectric times of minima. The light curves of V759 Cen show very shallow (Δ V = 0.2 mag) and almost equal minima, most of the light variation seems to be ellipsoidal. Because of these difficulties minima were misidentified when we reduced Bond's observations and primary and secondary minima were interchanged, this was realized when further observations were made. Here we present the results of UBV monitoring for minima of V759 Cen. The new minima are included in Table I: four from Bosque Alegre Station of Córdoba Observatory (JD 2442918 to 2444724) observed with the 1.54 m reflecting telescope and four (JD 2444808 to 2445079) from the 0.76 m reflector at El Leoncito of Félix Aguilar Observatory, San Juan, Argentina.

From all minima (old published values are also listed in Table I) now extending over 11000 cycles we determined the following least squares linear ephemeris:

$$\text{P.M.} = \text{JDhel } 2443089.2898 + 0^d.39399903 \times E$$
$$\pm.0012 \quad \pm.00000030$$

The O-C residuals from the above ephemeris in Table I are comparable to the estimated mean errors ($\sim 0^d.0035$) derived from the averages in the three wavelength determinations (compare for instance individual values as given by Sisteró and Castore de Sisteró, 1976). There are two minima exceeding twice the mean error, however determined from few individual observations on eclipses whose circumstances are not neatly defined.

TABLE I

Min	λ	JD hel 2440000 +	Cycles	(O - C)
II	y	649.8352	-6191.5	-0.0096
I	y	650.0381	-6191.0	-0.0037
I	UBV	2122.8210	-2453.0	+0.0108
II	UBV	2195.5031	-2268.5	+0.0001
I	UBV	2195.7033	-2268.0	+0.0033
I	UBV	2196.4909	-2266.0	+0.0029
II	UBV	2196.6865	-2265.5	+0.0015
II	UBV	2221.5128	-2202.5	-0.0059
I	UBV	2918.6848	-433.0	-0.0034
I	UBV	2920.6549	-428.0	-0.0033
I	UBV	4416.6735	+3369.0	+0.0010
II	UBV	4724.5822	+4150.5	-0.0006
II	UBV	4808.5078	+4363.5	+0.0032
II	UBV	5050.8099	+4978.5	-0.0041
I	UBV	5076.6194	+5044.0	-0.0015
I	UBV	5079.7701	+5052.0	-0.0028

R.F. SISTERO, B.A. CANDELLERO, S. MARTON and A. GRIECO

Observatorio Astronomico
and F.A.M.F.
Laprida 854
5000 Córdoba, Argentina

References:

Bond, H.E.: 1970, P.A.S.P., 82, 1065.
Sisteró, R.F. and Castore de Sisteró, M.E.: 1976, IBVS, No.1132.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3513

Konkoly Observatory
Budapest
5 September 1990
HU ISSN 0374 - 0676

THE CATACLYSMIC BINARY MV LYRAE RE-ATTAINED ITS UPPER LEVEL

Contrary to the expectation of some theoreticians the cataclysmic variable MV Lyrae has re-attained the brightness ($B \approx 12^m.5$) of its "active" state. We observed the star on plates of the Sonneberg 40 cm astrographs and of the Sky Patrol in continuation of our previous investigation (Wenzel and Fuhrmann 1989) and noticed that its mean brightness continued to increase in the last part of 1989, and after the sun gap the object has been presenting itself in the high state. The star had left this upper level in 1979 - for a complete long-term lightcurve before and including this fading see e.g. Wenzel and Fuhrmann (1983). Afterwards MV Lyrae showed an extraordinarily strong activity (Andronov, Fuhrmann, Wenzel 1988), characterized by eruptions rising from the minimum state, but never reaching the maximum high level.

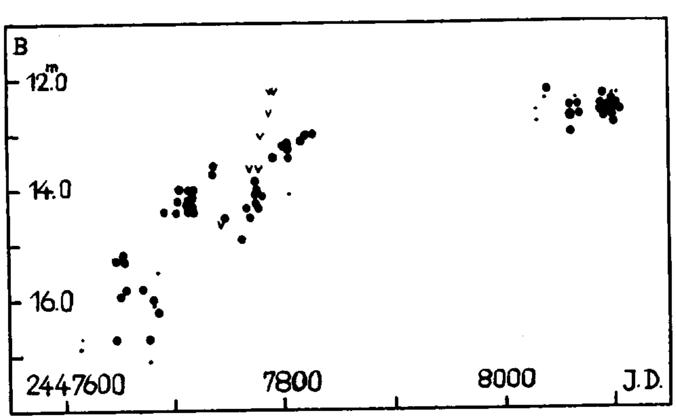


Figure 1

Figure 1 shows the ascending branch of 1989 and the maximum observations of 1990. The B system of comparison star magnitudes of Andronov and Shugarov (1982) was used; smaller dots denote values of less weight, and the arrows indicate "fainter-than" observations.

B. FUHRMANN, W. WENZEL
Sternwarte Sonneberg
Zentralinstitut für Astrophysik
Akademie der Wissenschaften der
DDR

References:

Andronov, I.L., Shugarov, S. Yu., 1982, Astron. Tsirk. No.1218,3

Andronov, I.L., Fuhrmann, B., Wenzel, W., 1988, Astron. Nachr. 309,39

Wenzel, W., Fuhrmann, B., 1983, Mitt. Veränderl. Sterne 9,175

Wenzel, W., Fuhrmann, B., 1989, Inf. Bull. Variable Stars No. 3391

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3514

Konkoly Observatory
Budapest
5 September 1990

HU ISSN 0374 - 0676

PHOTOMETRY OF THE NEW ECLIPSING BINARY DHK 16 = SAO 80992

Kaiser (1990) discovered that the 9th-magnitude star SAO 80992 = BD +26°1996 is an eclipsing binary, which he designated DHK 16 in his discovery list. The spectral type is G0, the position RA $9^h\ 41^m\ 22^s$, Dec +25° 35.1' (1950).

Regular visual monitoring by Baldwin soon detected additional minima. A discrete Fourier transform analysis of these visual observations by Kaiser produced several possible periods, the most promising being 0.69 day.

Williams observed the star photoelectrically with an Optec SSP-3 photometer and 28-cm Schmidt-Cassegrain. Most observations were made in the R band because of the variable's faintness with a 28-cm aperture and the photodiode's greater sensitivity at longer wavelengths. These observations (Figure 1) show that the 0.69-day DFT period is the half-period of an Algol-type eclipsing binary with nearly equal minima. A least-squares period solution using the discovery photo (HJD 2447968.691), one photoelectric minimum (the initial epoch of Equation 1), and six times of minima estimated from visual observations results in the preliminary light elements:

$$\text{Min. I} = \text{HJD } \underset{\pm .002}{2447999.617} + \underset{\pm .0002}{1^{d}\!.3742}\ E \qquad (1)$$

The comparison star was SAO 80978 (7.26 V, +1.10 B-V, K1III). Williams measured the comparison star and the variable at maximum in the V and R bands relative to several nearby stars from the Arizona-Tonantzintla Catalogue (Iriarte et al. 1965) and obtained the following results:

Comparison = SAO 80978 = 7.26 V, +0.80 V-R
Var (max) = SAO 80992 = 9.22 V, +0.54 V-R

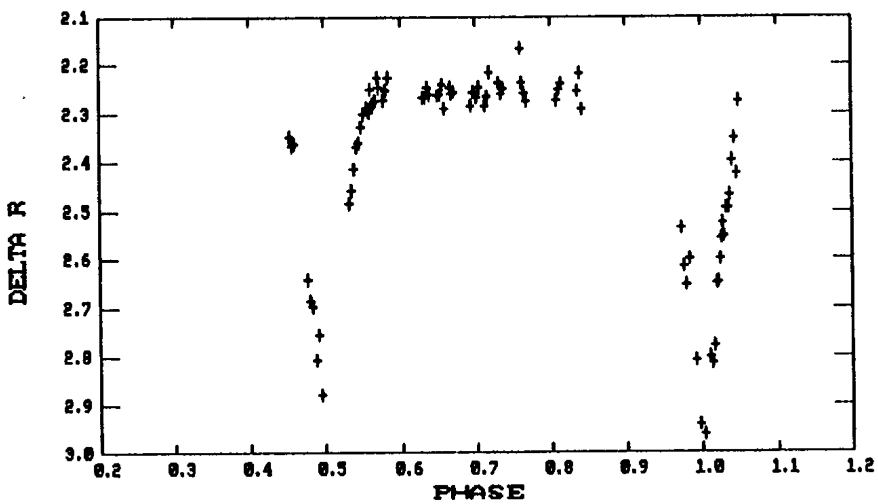


Figure 1. R-band differential photometry of DHK 16 = SAO 80992 phased according to Equation (1).

The eclipses appear to be partial, with duration of eclipse close to 0.10 P = 3.3 hours. Due to incomplete phase coverage and increased scatter when the variable was faint, the amplitudes of the two minima remain somewhat uncertain. However, available observations indicate that the primary minimum is $0^{m}_{.}70$ R deep and the secondary minimum is within $0^{m}_{.}1$ of the primary.

DAVID B. WILLIAMS
9270-A Racquetball Way
Indianapolis, IN 46260
USA

MARVIN E. BALDWIN
Route 1
Butlerville, IN 47223
USA

DANIEL H. KAISER
2631 Washington Street
Columbus, IN 47201
USA

REFERENCES

Iriarte, B., Johnson, H. L., Mitchell, R. I., Wisniewski, W. K., 1965, Sky & Telescope, 30, 21.

Kaiser, D. H., 1990, Inform. Bull. Var. Stars No. 3480.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3515

Konkoly Observatory
Budapest
10 September 1990
HU ISSN 0374 - 0676

SEARCH FOR SLOW LIGHT VARIATIONS OF RED DWARF STARS. II

Eight active late-type dwarfs were studied for long-term variability in the mean light using the Sternberg Institute plate collection by the method published in [1]. The yearly mean light for the investigated stars and their comparison stars are shown in Figures 1 and 2. The vertical bars in Figures represent standard deviations of single measurement from yearly mean as it has been made in [2]. The total number of plates for each star is given in Figures. The measurement errors were not larger than $0\overset{m}{.}07$ and the light variations with amplitude more $0\overset{m}{.}2$ can be suggested as real. The stars in Figure 1 - CU Cnc, CV Cnc, and V780 Tau - showed such variations. On the light curves of these stars one can see the smooth changes or decreases in some time intervals of about 10 or more years with amplitudes up to $0\overset{m}{.}3$. The large scatter in several years indicates the short-term variations during the year. For V780 Tau the amplitude of such variations exceeds $0\overset{m}{.}5$.

All stars in Figure 2 did not show the visible variability in mean light. But the mean light for only one star - OU Gem - can be considered as constant with confidence. For the other stars the data are scanty and additional investigations are needed.

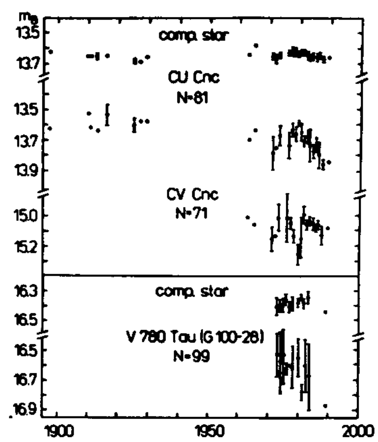


Fig.1. The mean light curves for the stars with suspected variability

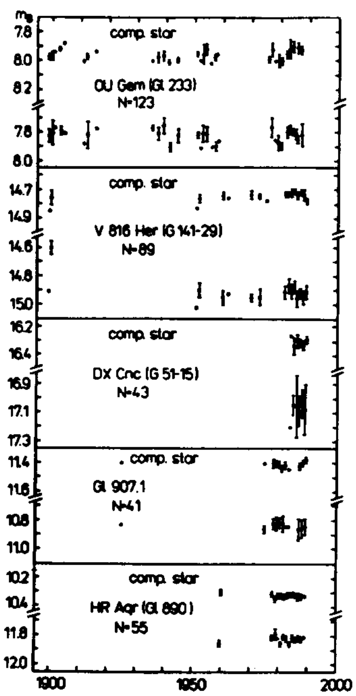


Fig.2. The mean light curves for the stars with no certain variability

N.I.BONDAR'
Crimean Astrophysical Observatory
Nauchny,Crimea,334413 USSR

REFERENCES

1.Bondar',N.I. 1990, in Flare stars in star clusters, associations and the solar vicinity, eds. L.V.Mirzoyan and B.R.Pettersen (Reidel, Dordrecht), in press

2. Phillips,M.J., and Hartmann,L. 1978 , Astrophys. Journal, **224**, 182-184.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3516

Konkoly Observatory
Budapest
12 September 1990
HU ISSN 0374 - 0676

ARE THE ALGOL-TYPE STARS V438 CENTAURI, V1156 CYGNI, AND V929 OPHIUCHI SURROUNDED BY ACCRETION DISCS? - A CALL FOR OBSERVATIONS

In a systematical search we looked for infrared excess radiation emitted from Algol-type variables. For this aim we compared the coordinates of such variables and infrared point sources contained in the catalogues compiled by Kholopov (1982, 1985, 1987) and Beichman et al. (1985). The coincidence of the coordinates within the individual error boxes given in the catalogues has been defined as a positive identification. The observed infrared fluxes in the IRAS 12, 25, 60, and 100 μm passbands have been converted into colour-corrected-ones assuming a power law correction (Beichman et al.,1985). From these values flux ratios F12/F25 and F25/F60 have been calculated. Their quantities cover a relatively large range.

Modelling X-ray binaries Smith et al. (1990) discussed the properties of accretion discs in such systems. In the frame of their assumptions these authors found that from the accretion discs infrared radiation can be emitted, too. Within certain limits the theoretically calculated flux ratios obey a relation ln(F12/F25) $\sim$ ln(F25/F60). In a corresponding diagram altogether 56 of the selected infrared sources possessing values ln(F12/F25) and ln(F25/F60).> -1 are distributed near the theoretical relation. Three of them V438 Cen, V1156 Cyg, and V929 Oph (listed in Table 1) match the theoretical relation within the error boxes arising from the uncertainties of the measured infrared fluxes. Above all we would turn to the presentation of the collected data for these three objects. Unfortunately, for these variables there is a lack of accurate photometric data in the optical as well as ultraviolet spectral region. Existing estimates of the magnitudes are based only on photographic plates (Table 1). Table 2 contains all relevant IRAS data concerning those objects which can be regarded as promising candidates possessing accretion discs.

Table I

Variable	Type of variability	Period (d)	Magnitude max	min	Literature
V438 Cen	E ?	?	11.8	12.2	Erro (1940)
V1156 Cyg	EA/DM:	44.5647	13.5	14.3	Wachmann (1966)
V929 Oph	EA/SD:	2.3401	15.0	15.6	Götz and Wenzel (1956)

Table II

IRAS Data	V438 Cen	V1156 Cyg	V929 Oph
Flux density uncertainties (in units $\delta f_\nu / f_\nu$):			
12 µm	0.04 – 0.08	0.04 – 0.08	0.04 – 0.08
25 µm	0.04 – 0.08	0.08 – 0.12	0.04 – 0.08
60 µm	0.08 – 0.12	/	/
100 µm	/	/	/
Correlation coefficient for compact IR sources:			
12 µm	100	100	100
25 µm	100	100	100
60 µm	99	90	/
100 µm	/	99	/
Variability in 12, 25 µm passbands:	20 – 29 %	10 – 19 %	20 – 29 %
Confusion with other sources:			
C1	0	0	4
C2	5	8	5
PH	0	1	0
PW	0	0	0

C1: Number of point sources at 100 µm in 0.5°x0.5° around the IR source in question.

C2: Ratio of a 0.5° extended 100 µm emission to the source flux: C2 < 4 – no influence of Cirrus; C2 > 4 – influence of Cirrus not negligible.

PH, PW: Numbers of nearby hours-confirmed (PH), weeks-confirmed (PW) sources within a box 12'x 9'.

Moreover, we found in our search among others infrared point sources at the positions of the variables DX Aquarii and CI Cygni, too. In both cases the infrared flux ratios derived from observations deviate in the IR flux ratio diagram remarkably from the theoretical relation obtained by Smith et al. (1990). Nevertheless, these variables deserve further attention for the explanation of their infrared excesses.

For DX Aquarii (≡ BD -17° 6422 ≡ HD 209758) numerous photoelectric observations mainly in the UBV system and spectroscopic data exist. A comprehensive summary concerning the changing photometric behaviour of this variable has been given by Srivastava (1986). According to the IRAS data the coinciding IR source is pointlike. No information concerning its IR variability is given.

CI Cygni is a photometrically and spectroscopically well-studied object which belongs to the Algol symbiotics. Relevant observational data are cited in the summarizing papers by Mikolajewska (1985) and Mikolajewska and Mikolajewski (1988). From spectroscopic as well as photometric observations the existence of an accretion disc around the main sequence star has been inferred by Chochol et al. (1984). The existence of a 10 μm infrared excess has been attributed to the presence of an evolved red giant. According to IRAS data a pointlike IR source matches perfectly the position of CI Cygni. The IRAS fluxes show no sign of variability.

The attempt to identify all above mentioned variables with X-ray sources listed in different catalogues (Giacconi et al. 1972, 1974, Forman et al. 1978, Cooke et al. 1978, Marshall et al. 1979, Amnuel et al. 1979, Nugent et al. 1983, Levine et al. 1984, Wood et al. 1984) failed.

In case of V438 Cen, V1156 Cyg, and V929 Oph high quality photoelectric observations in as much as possible standard passbands are highly desired. Such a data base would be a useful tool for the detection of the presumed asymmetries and variations in the light curves arising from hot spots on those components surrounded by accretion discs.

C. FRIEDEMANN, M. LÖWE

University Observatory Jena
Schillergäßchen 2,
6900 Jena, GDR

References:

Amnuel, P.R., Guseinov, O.H., and Bakhaminov, Sh.,Yu.: 1979, Astrophys. J. Suppl. Series 41, 327

Beichman, C.,A., Neugebauer, G., Habing, H.J., Clegg, P.E., and Chester, T.J.: 1985, Infrared Astronomical Satellite (IRAS), Catalogs and Atlasses

Chochol, D. Vittone, A., Milano, L., and Rusconi, L.: 1984, Astron. Astrophys. 140, 91

Cooke, B.A. et al.: 1978, Monthly Not. R.A.S. 182, 489

Erro, L.E.: 1940, Harvard Bull. No. 913

Forman, W. et al.: 1978, Astrophys.J. Suppl. Series 38, 357

Giacconi, R. et al.: 1972, Astrophys. J. 178, 281

Giacconi, R, et al.: 1974, Astrophys. J. Suppl. Series 27, 37

Götz, W. and Wenzel, W.: 1956, Veröff. Sternwarte Sonneberg 2, No. 5

Kholopov, P.N.: 1982, Ed. in Chief, New Catalogue of Suspected Variable Stars, Moscow, Publishing Office 'Nauka'

Kholopov, P.N.: 1985, Ed. in Chief, General Catalogue of Variable Stars, Part I and II, Moscow, Publishing Office 'Nauka'

Kholopov, P.N.: 1987, Ed. in Chief, General Catalogue of Variable Stars, Part III, Moscow, Publishing Office 'Nauka'

Levine, A.M. et al.: 1984, Astrophys. J. Suppl. Series 54, 581

Marshall, F.E.: 1979, Astrophys. J. Suppl. Series 40, 657

Mikolajewska, J.: 1985, in 'Recent Results on Cataclysmic Variables', Ed. W.R. Burke, Proc. ESA Workshop held at Bamberg, SP-236, p. 101

Mikolajewska, J. and Mikolajewski, M.: 1988, in 'The Symbiotic Phenomenon', Eds. J. Mikolajewska, M. Friedjung, S.J. Kenyon, and R. Viotti: Astrophysics and Space Science Library, Vol. 145, p. 187, Kluwer Academic Publishers, Dordrecht

Smith, H.A., Beall, J.H., and Swain, M.: 1990, Astron J. 99, 273

Srivastava, R.K.: 1986, Astrophys. Space Science 124, 397

Nugent, J.J. et al.: 1983, Astrophys. J. Suppl. Series 51, 1

Wachmann, A.A.: 1966, Astron. Abh. Hamburger Sternwarte No. 4

Wood, K.S.: 1984, Astrophys. J. Suppl. Series, 56, 507

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3517

Konkoly Observatory
Budapest
12 September 1990
HU ISSN 0374 - 0676

ON THE AMPLITUDE OF THE RECURRENT NOVA V 3890 SAGITTARII

The recent discovery of a new outburst (Jones 1990) of this object, which was originally called "Nova Sgr 1962" (for the description of the first maximum see Dinerstein 1973), caused me to check the available plates of the Sonneberg Sky Patrol at the location of the star. On 7 of 679 suitable exposures taken at Sonneberg and in Namibia mainly by P. Ahnert, C. Hoffmeister, and H. Huth in the years 1926 to 1983 the variable is visible during the 1962 eruption and shows the following pg. magnitudes:

243 7818.52	$10^m.5$
.54	10.6
7820.52	10.9:
7821.49	10.8
7824.45	11.1:
.47	11.0
.49	11.2

The first two plates of this list were taken at the date of the Nantucket discovery plate (1962 June 2). With certainty the maximal brightness determined by us is much fainter than the value of $8^m.4$ from the Nantucket exposure: The nova is only slightly brighter (by 0.4 mag at the most) than the nearby CoD -24^o14410 (star A of Dinerstein l.c.). The magnitude of A has been determined concurrently as $10^m.9$ by linking it to the Henry Draper Catalogue pg. brightness data of 5 neighbouring stars and independently to Selected Area 134 (the systematic correction of Seares et al. (1924) and the difference in atmospheric extinction taken into account). Also the other magnitudes, on the subsequent part of the descending branch, are systematically 1.5 to 2 mag fainter than the corresponding trend of the light-curve of Dinerstein. - At the remaining plates the star is invisible, fainter than $11^m.4$. We did not reach our goal to find some further eruption, and there is at present no possibility of correcting statistically the observed cycle length of 28 years.

The 1990 eruption of V 3890 Sgr should have reached visually $8^{m}.0$ at the most (Liller 1990; Jones 1990). The light-curve of this outburst very closely resembles that of 1962, if we assume photovisual magnitudes for the upper part of Dinerstein's curve. This assumption would be in accordance with our own magnitude determination on non-sensitized photographic plates if we pay regard to the positive colour index normally present in this phase of an eruption. An analogous example is V 745 Sco - pg. light-curve of 1937 see Duerbeck (1984), pv. maximum of 1989 see Liller (1989) et al.

From all these facts we conclude that the outburst amplitude might have been not much larger than 7 mag pg., and not > 9 mag as assumed possible by Duerbeck (1987) e.g. This newly determined outburst range is well fitting the amplitude-cycle length relationship: For the three recurrent novae RS Oph, T Pyx, and V 1017 Sgr with an amplitude of about 7 mag an average cycle length of 26 years was observed, and the values for the second group V 394 CrA, T CrB, U Sco, and V 745 Sco are approximately 10 mag and 50 years (see e.g. Hoffmeister et al. 1990).

W. WENZEL
Sternwarte Sonneberg
Zentralinstitut für Astrophysik der
Akademie der Wissenschaften
der DDR

References:

Dinerstein, H., 1973, Inf. Bull. Variable Stars 845
Duerbeck, H.W., 1984, Inf. Bull. Variable Stars 2490
Duerbeck, H.W., 1987, Space Sci. Rev. 45, no. 1-2,p.123
Hoffmeister, C., Richter, G., Wenzel, W., 1990, Veränderliche Sterne 3. Aufl., Verlag Barth, Leipzig,p.88
Jones, A.F., 1990, IAU Circ. 5002
Liller, W., 1989, IAU Circ. 4820; see also subsequent nrs. of the Circ.
Liller, W., 1990, IAU Circ. 5010
Seares, F.H., et al., 1924, Contr. Mt. Wilson Obs. 13,p.145

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3518
Konkoly Observatory
Budapest
14 September 1990
HU ISSN 0374 - 0676

THE CHANGING LIGHT CURVE OF THE Ap STAR 41 TAURI

The Ap star 41 Tau≡HD 25823≡GS Tau was found to be variable by Rakos (1962). He reported a period of 11.94 d, a value also adopted by Blanco and Catalano (1972). Abt and Snowden (1973) discovered the spectroscopic binarity of 41 Tau and determined an orbital period of 7.227424 d. Wolff (1973) reported new and more accurate photometric measurements and established the synchronism between rotation and revolution. On the basis of the new value of the period, Rakos (1974) rediscussed his old photometric measurements: to our knowledge this is the last report about 41 Tau.

In December 1989 and January 1990 we intensively observed the δ Scuti star 44 Tau, located near 41 Tau, with the 50–cm reflector of Merate Observatory. Although the constancy of the comparison star 42 Tau was widely proved by several previous observers, we decided to measure 41 Tau in addition to the check star HD 25823 in order to test the stability of our instrumentation with a small amplitude, long period variable star. The results described here give very comfortable indications about this point. In each night a number of individual measurements ranging from 5 to 16 were collected and grouped into the normal points listed in the table (in the four columns the mean time of observation, the mean V magnitude, the number of measurements and the standard deviation of a single measurement are reported). The V standard magnitudes were calculated assuming V= 5.23 for the comparison star 42 Tau (*Bright Star Catalogue*).

As a first step, we performed a period search using a least-squares method and we were able to confirm the photometric period reported by Wolff (1973): the power spectrum is reported in the figure 1. As it can be noticed, owing to our time sampling, the alias peak at $1-f$ is as high as the peak at f=0.13 c/d. Once the value of the period was confirmed, we performed a Fourier analysis in order to evaluate the importance of the harmonic $2f$: the calculated semi-amplitudes are 0.010 mag and 0.004 mag for f and $2f$, respectively. The standard deviation of the fit is 0.0018 mag: this is the expected value for our set of normal points obtained by averaging $N \sim 15$ measurements, performed by an instrumentation (regarded as the ensamble of sky conditions, telescope, photometer and data acquisition system) characterized by a standard deviation of 0.007–0.008 mag (see the last column of the table); this is also the value obtained from the observations of the check star.

Table I

Hel. J.D. 2447000.+	V	N	s.d.	Hel. J.D. 2447000.+	V	N	s.d.
862.507	5.199	8	0.009	895.344	5.183	12	0.004
864.455	5.176	12	0.005	896.349	5.185	13	0.006
865.387	5.182	8	0.009	902.337	5.180	10	0.004
865.515	5.181	8	0.007	903.344	5.186	8	0.006
866.424	5.180	9	0.004	904.355	5.195	8	0.004
867.346	5.187	9	0.008	905.333	5.204	16	0.005
867.518	5.185	5	0.004	906.336	5.197	15	0.003
868.446	5.194	8	0.008	908.338	5.180	9	0.004
869.431	5.199	11	0.008	909.315	5.182	9	0.003
888.403	5.183	11	0.007	911.314	5.188	7	0.008
889.404	5.185	12	0.010	912.320	5.199	16	0.007
890.413	5.195	13	0.005	913.312	5.201	16	0.007
891.381	5.200	10	0.005	914.299	5.185	8	0.008
894.364	5.179	11	0.004	939.283	5.185	10	0.003

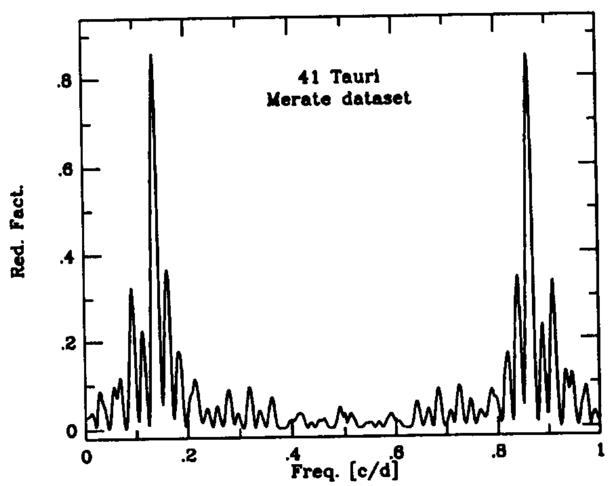


Figure 1

We repeated the analysis with the measurements reported by Wolff (1973): we obtained identical values for the frequency of the highest peak in the power spectrum and for the amplitude of the term with frequency f, but a different amplitude of the term with frequency $2f$ (0.002 mag). This discrepancy and a slight difference in the $\phi_{21} = \phi(2f) - 2\phi(f)$ parameter, where ϕ's are the phases, (5.6 ± 0.2 rad for our measurements, 4.5 ± 0.4 rad for Wolff's ones) originate two different light curves, as it can be seen in the two panels of the fig. 2, where the two sets of measurements were reported with the respective least-squares interpolating light curve. The different mean magnitudes of the two curves are due to the fact that Wolff adopted for the comparison star 42 Tau a different V magnitude (V=5.196) than the one adopted by us. Both maxima of the two curves have been arbitrarily set to zero phase.

We can conclude that the shape of the light curve of 41 Tau is variable on a timescale of a few years. We also note that the light curves reported by Rakos (1974) for the years

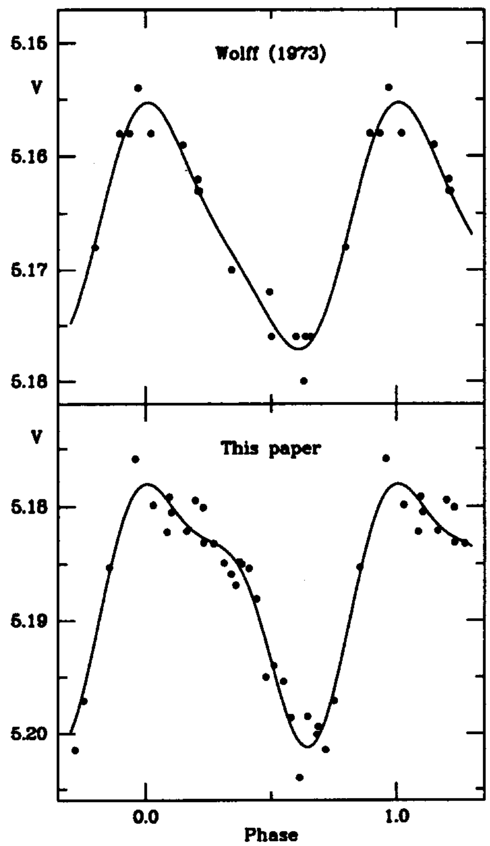


Figure 2

1960 and 1963-64 show a flat maximum, i.e. a third different behaviour. On the other hand the times of maximum light computed from the present measurements and those of Blanco and Catalano (1972) and Wolff (1973) have similar phases with respect to the ephemeris of the periastron passage (Abt and Snowden, 1973): 0.34, 0.42 and 0.42, respectively.

L. MANTEGAZZA[1], E. PORETTI[2], E. RIBONI[2]

1–Dipartimento di Fisica Nucleare e Teorica
Università di Pavia

2–Osservatorio Astronomico di Brera
Via Bianchi, 46
22055 Merate – Italy

References:

Abt,H.A., Snowden,M.S.: 1973, Astrophys.J.Suppl. **25**, 137
Blanco,C., Catalano,F.A.: 1972, Astron.J. **77**, 666
Rakos,K.D.: 1962, Lowell Obs.Bull. **5**, 227
Rakos,K.D. : 1974, Astron.Astrophys. **34**, 297
Wolff,S.C. : 1973, Astrophys.J. **186**, 951

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3519

Konkoly Observatory
Budapest
17 September 1990
HU ISSN 0374 - 0676

UNUSUAL PHOTOMETRIC CHARACTER OF THE S-CEPHEID FF Aql

Photoelectric observations of the s-Cepheid FF Aql were obtained in October 1988 in Abastumany Astrophysical Observatory. The data was obtained by using the 0.48-m AZT-14 reflector with a UBV photoelectric photometer. HR 7260 was the comparison star (V=6.146, B-V=0.769, U-V=0.995) (Arellano Ferro 1984).

During seven observational nights there were obtained 18 V, B-V and U-V estimates. Phases were calculated according to Arellano Ferro (1984): HJD(max)=2444862.617+$4^{d}.470916 \cdot$ E. Observational data are tabulated in Table I, light and colour curves are represented in Figure 1.

It is seen from Fig. 1, that most of the obtained V and B-V estimates are in good agreement with light and colour curve from Arellano Ferro's (1984) work. The agreement in the U-V observations is noticeably less. Some V, B-V and U-V estimates are quite unexpected. So, in the night of October 22/23 (HJD 2447454), the first two estimates (noted as points 1 and 2 , respectively) are in good agreement with the light curve. Then, an almost $0^{m}.1$ (point 3) brightness increase occurred in V followed by an $0^{m}.4$ (point 4) fading. B-V and U-V curves showed contrary change, at first decreasing, then increasing colour indices. Abrupt dimming of FF Aql's light was observed in the night of October 6/7 (HJD 2447441) manifesting in slight change of B-V and U-V estimates (points 5 and 6). It is interesting, that U-V estimates in points 5 and 6 are in the best agreement with U-V curve by Arellano Ferro (1984).

For the sake of clarity, the present V, B-V, and U-V observations were compared with the previously published ones. As we know, the pulsational period of FF Aql, in principle, is almost unvariable for all observations of this Cepheid. Small changes of the pulsational period are explained by presence of a blue companion B8 V (Balona 1977, Usenko 1990), with an orbital period of 1400^{d}-1435^{d} (Abt 1959, Szabados 1977). Therefore, V, B-V and U-V measurements by Arellano Ferro (1984), Mitchell et al. (1964), Szabados (1977) were adduced for epoch HJD 2444862.617 and plotted in Fig. 1. It is

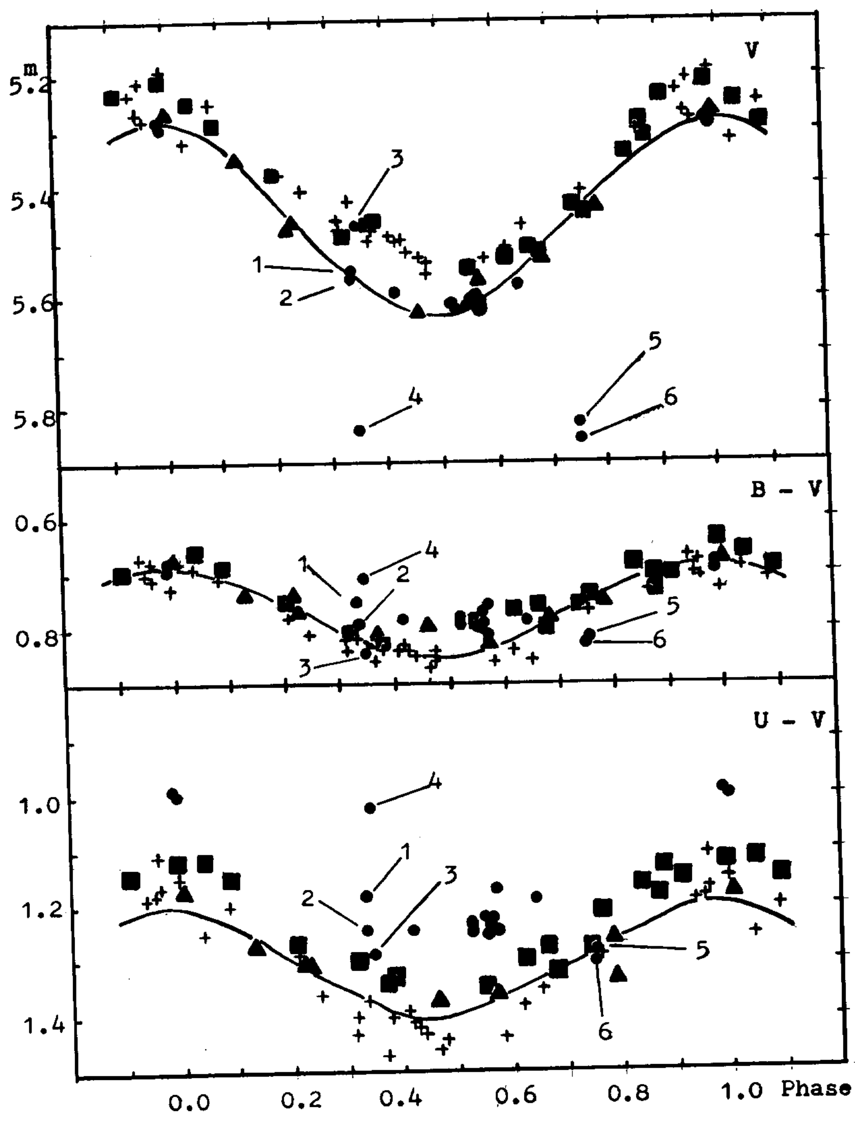


Figure 1

FF Aql light and colour curves. The symbols are: circles: this work, triangles: Arellano Ferro (1984), crosses: Mitchell et al. (1964), squares: Szabados (1977). Light and colour curves plotted according Arellano F. (1984).

Table I.

HJD 2447400+	V	B–V	U–V	Phase
40.1997	5.616	0.784	1.250	0.522
40.2034	5.622	0.789	1.239	0.523
41.2156	5.832	0.826	1.301	0.750
41.2167	5.858	0.818	1.287	0.750
44.2055	5.590	0.786	1.249	0.418
45.1954	5.579	0.789	1.189	0.640
51.2227	5.285	0.692	0.995	0.988
51.2327	5.292	0.684	0.999	0.990
57.2477	5.556	0.753	1.187	0.335
57.2516	5.561	0.797	1.247	0.336
57.2980	5.469	0.847	1.292	0.347
57.3016	5.841	0.710	1.024	0.347
58.2093	5.618	0.795	1.223	0.550
58.2138	5.611	0.799	1.254	0.551
58.2480	5.602	0.790	1.237	0.559
58.2513	5.618	0.775	1.227	0.560
58.2897	5.623	0.759	1.172	0.568
58.2930	5.612	0.817	1.248	0.569

seen, that FF Aql's light curve is separated on two curves. It is interesting, that the V-estimate on point 3 lies on the upper curve well. On B-V plane this separation is not noticed. Large scatter of estimates at U-V curve by Arellano Ferro (1984) is observed, that characterises Cepheids with obvious or suspected blue companions (Lloyd Evans 1968).

This unusual separation of FF Aql's light curve may be explained by its possible amplitude modulation from the companion's perturbation. This amplitude modulation is known in V473 Lyr (HR 7308). If it is true, so it is a good confirmation of the hypothesis about possible duplicity of V473 Lyr (companion B7-B8 V according Usenko, 1990). It is important to note, that it is necessary to obtain more careful observations of FF Aql, that can give more thorough information about this binary system.

IGOR A. USENKO

Astronomical Observatory of Odessa
State University. Odessa, USSR

References:

Abt, H.A.: 1959, Astroph. J. 130, 769.
Arellano Ferro, A.: 1984, M.N.R.A.S. 209, 481.
Balona, L.A.: 1977, M.N.R.A.S. 178, 231.
Lloyd Evans, T.: 1968, M.N.R.A.S. 141, 109.
Mitchell, R.I., Iriarte, B., Steinmetz, D., Johnson, H.L.: 1964, Tonantzintla Bol. 3, 153.
Szabados L.: 1977, Budapest Mitt. No. 70.
Usenko, I.A.: 1990, Kinemat. i Fizika Nebesn. Tel. 6, No. 3, 91.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3520

Konkoly Observatory
Budapest
28 September 1990
HU ISSN 0374 - 0676

HD 12932, A NEW RAPIDLY OSCILLATING CP2 STAR*

In 1973 Bidelman and MacConnell published "early results" from the jet unfinished project, an MK classification of all southern HD stars. Among other peculiar objects they also present a list of CP2 stars in their paper. The 10.3 magnitude star HD 12932 was classified in this list with a SrEu peculiarity and strong K and H+Hϵ lines. No further information about this star is published so far (SIMBAD data bank).

HD 12932 was included recently in our survey for rapidly oscillating CP2 stars, which was initiated by us at ESO (La Silla) in 1978. The star was oberved the first time in 1988 during three nights, Sep 5-8, with the Dutch 90cm telescope and the Walraven $VBLUW$ photometer at La Silla/Chile (ESO). HD 12932 was monitored continuously with an integration time of 16^s for about three hours a night, only occasionally interrupted to measure the sky and/or to check the centering of the star in the diaphragm.

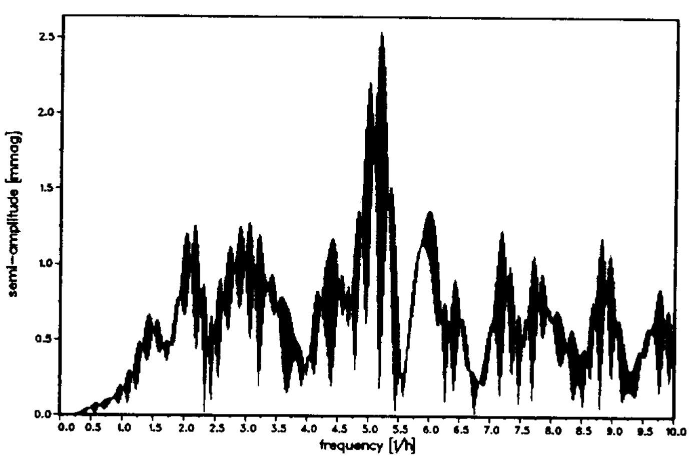


Fig.1: Amplitude spectrum for HD 12932 of the entire 1988 data set, 0.9m Dutch telescope at ESO, Walraven-B.

---

* Based on observations collected at the European Southern Observatory (La Silla, Chile) in the framework of the European Working Group on CP stars.

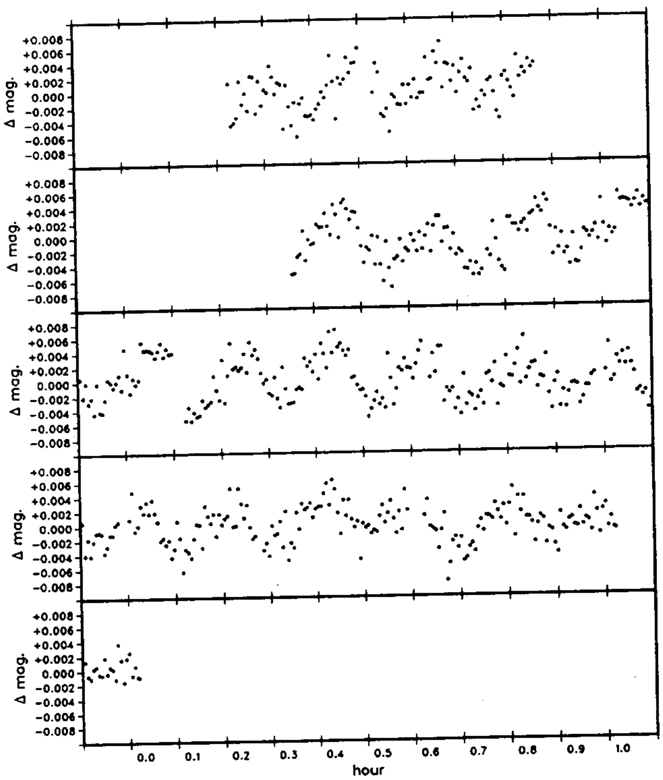


Fig.2: Light curve of HD 12932 during the night of August 28/29. 1990, in Johnson–B, ESO 1m-telescope.

Our observing and reduction procedure is described in more detail in Schneider and Weiss (1983) and in Weiss and Schneider (1984).

We were looking for periods of 5 to 20 minutes, and therefore no comparison star was observed. Although this means that there is no compensation of fluctuations of the sky transparency, such changes will be at random and slow enough to allow for an elimination of these effects by applying a low-frequency filter. This procedure is standard in observing rapidly oscillating CP2 stars from a good photometric site.

The data were analysed with Fourier techniques, using the slightly modified algorithm of Deeming (1975). In Figure 1 we present the amplitude spectrum of the entire Walraven-B data. A peak at $f = 5.17$ c/h (11.6 minutes) with an amplitude of about 2.5mmag is clearly above the noise level. This peak is also present in our V and L data, while in U and W the amplitudes exceed only marginally the noise level.

To confirm the discovery of a new rapidly oscillating CP2 (roAp) star we planned to observe HD 12932 again in 1989, but unfortunately we were granted only telescope time at the 50cm SAT, which is too small for the required photometric accuracy. However, in August 1990 we were able to obtain high quality photometric data with the ESO 1m-telescope (Johnson-B) of which we present the pulsation light curve of HD 12932 during the night of 1990, Aug. 28-29., (Figure 2) as an example.

We thus announce the discovery of another rapidly oscillating CP2 star, HD 12932, which will be the 15th member of this group so far. Further observations will be carried out by the authors in the near future to determine more precisely the power spectrum of this object.

HARTMUT SCHNEIDER
Universitäts-Sternwarte
Geismarlandstr. 11
D-3400 Göttingen

WERNER W. WEISS
Institut für Astronomie
Türkenschanzstr. 17
A-1180 Wien

References:

Bidelman, W. P., MacConnell,D.J.: 1973, *Astron. J.* **78**, 687

Deeming, T. J.: 1975, *Astrophys. Space Sci.* **36**, 137

Schneider, H., Weiss, W. W.: 1983, *Inf. Bull. Var. Stars* No. 2306

Weiss, W. W., Schneider, H.: 1984, *Astron. Astrophys.* **135**, 148

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3521

Konkoly Observatory
Budapest
1 October 1990

HU ISSN 0374 - 0676

A PERIOD ANALYSIS OF THE SEMI-REGULAR VARIABLE SW VIR*

SW Vir (HD 114961) is a semi-regular SRb variable of spectral type M7III with an amplitude of approximately one and one-half magnitudes in V (Kholopov et al. 1985). Its variability was discovered by W. P. Fleming in 1901 from photographic plates of the Henry Draper Memorial (Pickering 1901). In the Second Catalog of Variable Stars, Cannon and Pickering (1907) listed the period as irregular and the magnitude range as 7.4 to 8.8 from a combination of visual and photographic measurements. Lause (1929) derived a period of 157 days and a time of maximum of JD 2425291. From a total of 2679 photographic observations covering the years 1890 to 1938, Payne-Gaposchkin (1952) derived 45 times of maximum and 39 times of minimum and from them a period of 150 ± 22 days. The total magnitude range during that interval was given as 8.17 to 9.40.

SW Vir was placed on the observing menu of the Smithsonian 10-inch Automatic Photoelectric Telescope (APT) in 1986 when it was relocated from Fairborn Observatory in Ohio to the Smithsonian Institution's F. L. Whipple Observatory on Mt. Hopkins in southern Arizona (Genet and Boyd 1987, Baliunas et al. 1987, Genet and Hayes 1989). The APT is equipped with an Optec SSP-3a photometer (Persha and Sanders 1983) and observes in the Johnson V, R, and I bandpasses. Five seasons of APT data from 1986 to 1990 have been obtained on SW Vir. Figure 1 shows the V band light variations plotted against heliocentric Julian Date. Each point is the mean of three differential observations and has been corrected for differential extinction and transformed to the Johnson system. Means with a standard deviation of 0.02 magnitudes or greater have not been plotted and are not used in this analysis. The comparison star was HR 5047 (V = 5.89) giving a total magnitude range of 6.65 to 7.95 in V.

A period search was performed on the APT data by looking at residuals from fits of sinusoids over the range of trial periods from 1 to 1500 days. The resulting periodogram for the V data is shown in Figure 2 where the sums of the squares of the residuals to the sine fits are plotted against trial period. The deep minimum yields a period of 162.4 ± 0.5 days for SW Vir where the uncertainty is computed by the method of Hooten and Hall (1990). Two shallower minima occur at 113 and 285 days which correspond to the one year aliases of the true period resulting from the seasonal gaps in the data.

Table I gives the times of maximum of SW Vir estimated from the APT light curves along with their estimated uncertainties. Also included is a well-defined maximum estimated from 1970 photoelectric photometry by Wisse and Wisse (1971). The interval

*Based on data from the Automatic Photoelectric Telescopes of the Smithsonian Astrophysical Observatory

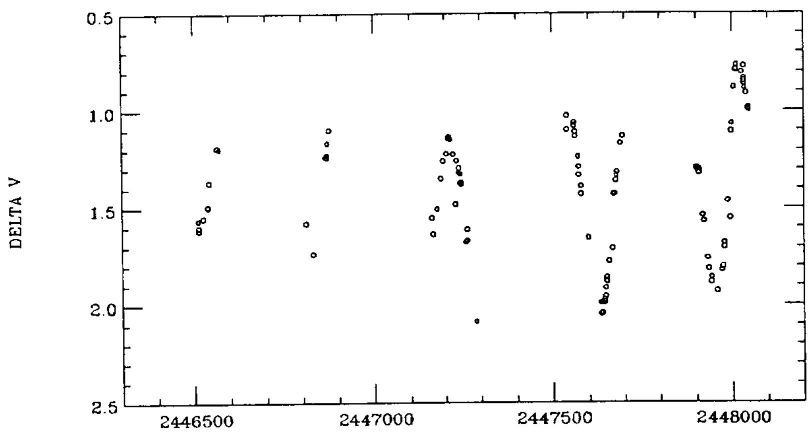


Figure 1: V band APT light curve of SW Vir from 1986 to 1990.

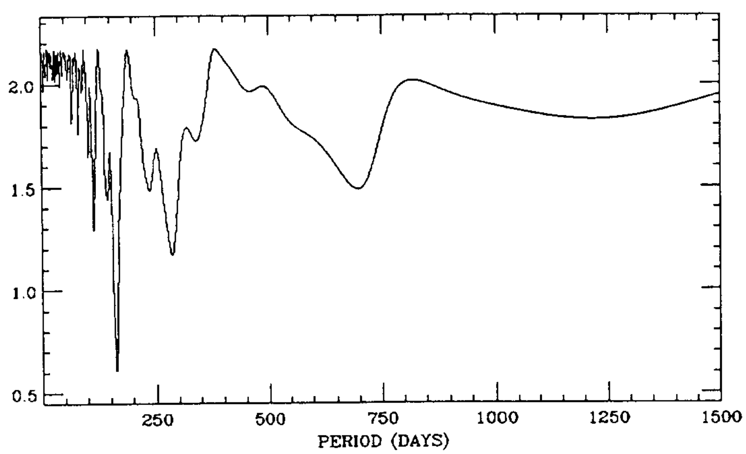


Figure 2: Periodogram of the SW Vir data from Figure 1.

between JD 2440711, the maximum of Wisse and Wisse, and JD 2447210, the well-defined maximum in the third year of the APT data, is 6499 days or 40.02 cycles of the 162.4 day period derived above. This implies that the cycle count has not been lost in the intervening two decades between these sets of data. Considering the uncertainty of three days in the times of these two maxima, a slightly improved period of 162.5 ± 0.2 days can be derived and the following ephemeris given:

$$\mathrm{JD\,(max.)} = \underset{\pm 3}{2447210} + \underset{\pm 2}{162.5}\,E$$

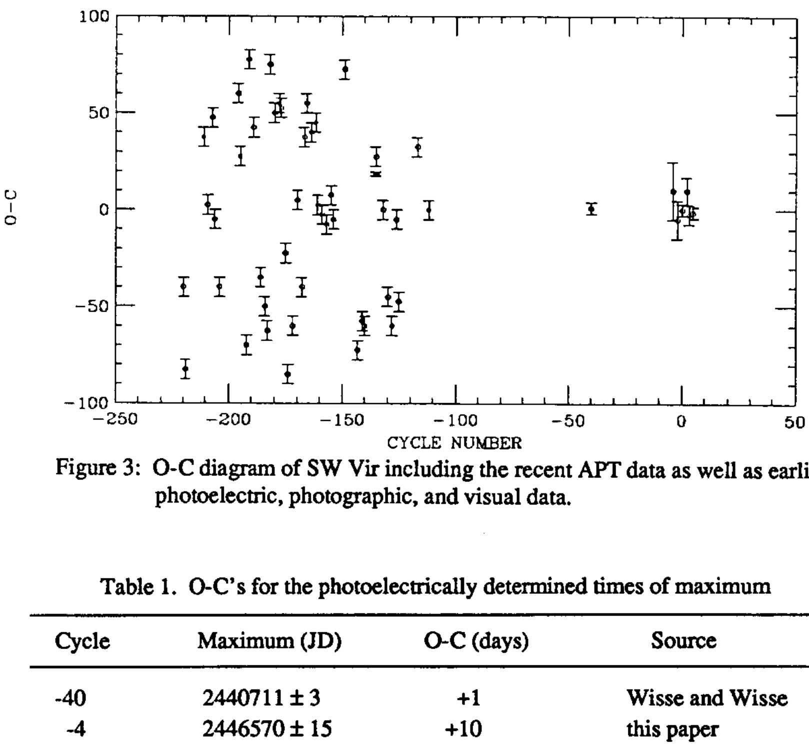


Figure 3: O-C diagram of SW Vir including the recent APT data as well as earlier photoelectric, photographic, and visual data.

Table 1. O-C's for the photoelectrically determined times of maximum

Cycle	Maximum (JD)	O-C (days)	Source
-40	2440711 ± 3	+1	Wisse and Wisse
-4	2446570 ± 15	+10	this paper
-2	2446880 ± 10	-5	this paper
0	2447210 ± 3	0	this paper
+2	2447545 ± 7	+10	this paper
+3	2447695 ± 5	-2.5	this paper
+5	2448021 ± 3	-1.5	this paper

The differences between the observed and computed times of maximum (O-C) calculated from this ephemeris are listed in Table 1 and plotted in Figure 3 where the O-C's derived from the Payne-Gaposchkin and Lause maxima are also included. While the photoelectric data (1970 -1990) are consistent with a constant period of 162.5 days, the earlier photographic and visual data (1890 - 1938) are not. In fact, the earlier O-C's scatter over the entire range of the period. The SRb classification of SW Vir seems to be consistent with the early data, but the stable period of the later data suggests a classification of SRa. SW Vir may be similar to certain semi-regular variables discussed by Cadmus et al. (1990) that exhibit sudden amplitude and period variations suggested to be due to pulsation mode switching. SW Vir will continue to be monitored by the Smithsonian 10-inch APT.

This work was supported by the Smithsonian Institution, the Richard Lounsbery Foundation, the Mobile Foundation, and N.A.S.A. Training Grant NGT-40021 to the Tennessee Valley Aerospace Consortium. We also thank Irwin Shapiro for his support and encouragement of the APT program.

JAMES E. ARMOUR[1]
GREGORY W. HENRY[1]
SALLIE L. BALIUNAS[1,2,3]

1) Center of Excellence in Information Systems, Tennessee State University, 330 10th. Ave. North, Nashville, TN 37203
2) Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS 15, Cambridge, MA 02138
3) Department of Physics and Astronomy, Dartmouth College, Hanover, NH 30755

References:

Baliunas, S. L., Donahue, R. A., Loeser, J. G., Guinan, E. F., Genet, R. M., and Boyd, L. J. 1987, *New Generation Small Telescopes*, D. S. Hayes, R. M. Genet, and D. R. Genet eds. (Mesa: Fairborn Press), p. 97.

Cadmus, R. R., Willson, L. A., Sneden, C., and Mattei, J. A. 1990, *Astron. J.*, submitted.

Cannon, A. J. and Pickering, E. C. 1907, *Annals of Harvard College Observatory*, Vol. 55, part 1.

Genet, R. M. and Boyd, L. J. 1987, *New Generation Small Telescopes*, D. S. Hayes, R. M. Genet, and D. R. Genet eds. (Mesa: Fairborn Press), p. 85.

Genet, R. M. and Hayes, D. S. 1989, *Robotic Observatories*, (Mesa: Autoscope), pp. 21-28.

Hooten, J. T. and Hall, D. S. 1990, *Astrophys. J. Suppl.* **74**, 225.

Kholopov, P. N. et al. 1985, *General Catalog of Variable Stars*, 4th ed. (Moscow: Nauka).

Lause, F. 1929, *Beob. Zirk. der Astr. Nachr.*, No. 27.

Payne-Gaposchkin, C. 1952, *Annals of Harvard College Observatory*, Vol. 115, No. 26.

Persha, G. and Sanders, W. 1983, *Advances in Photoelectric Photometry*, Vol. 1, R. C. Wolpert and R. M. Genet eds. (Fairborn: Fairborn Observatory), p. 130.

Pickering, E. C. 1901, *Harvard College Observatory Circulars*, No. 54.

Wisse, M. and Wisse, P. N. J. 1971, *Astr. and Astrophys.* **12**, 143.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3522

Konkoly Observatory
Budapest
1 October 1990

HU ISSN 0374 - 0676

QUIESCENT LIGHT VARIATION OF UV Per

UV Per was confirmed as an SU UMa type dwarf nova with the superhump period of 95.5 minutes (Udalski and Mattei, 1989). But neither radial velocity study nor search for photometric periodicity in quiescence have been undertaken to determine the orbital period.

Our observations were done with Thomson CCD (576×384 pixels, on chip summation of 2×2 pixels) attached to the Cassegrain focus of the 60cm reflector at the Ouda Station on August 5, 1990. The Johnson V filter was employed and the exposure time was 480 seconds.

The frames were processed with the point spread function (PSF) photometry package developed by the author. PSF profiles were empirically determined from other nine brighter stars in the same frame. We converted our instrumental (differential) magnitudes into the V mags., using the Guide Star Catalog (GSC) for 12 stars between V=10.8 and V=13.4 in the same frame. The resulting zero point is 11.6 ± 0.1 in magnitude.

Figure 2 illustrates the processed CCD image containing the variable (V) and the check star (C). When compared with the position in POSS print (Bruch, Fischer and Wilmsen, 1987), UV Per shifts roughly 3 arcsec towards east. This large proper motion deserves further astrometric observations.

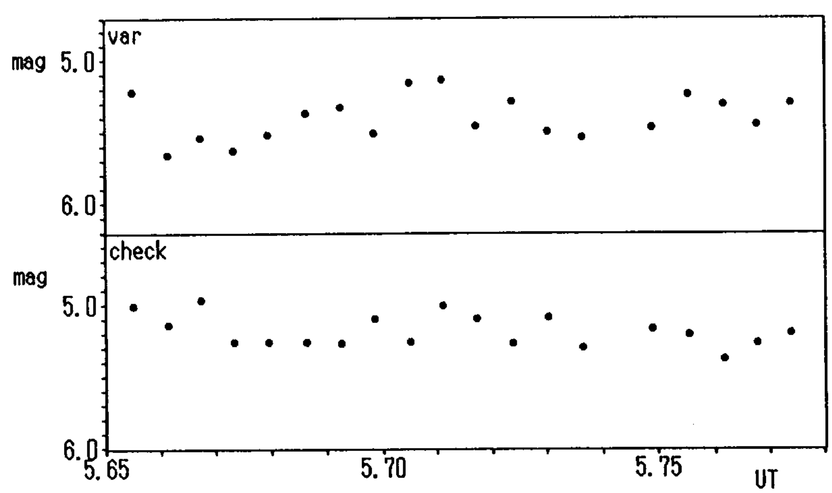


Figure 1.

The mean brightness of UV Per in this run was V=17.0 ± 0.1, in good agreement with that given by Szkody (1985). Table 1 and Figure 1 gives our result for UV Per and the check star. The expected r.m.s. error of a single observation of UV Per is about 0.11 mag., due to the high sky count in the nearly full moon. One can see roughly sinusoidal variation with an amplitude of 0.6 magnitude and two rather distinct minima separated by about 1.5 hours. The maximum entropy method gives the most probable period of 89.6 minutes and expected one sigma error of 0.4 minutes. Superhump periods in SU UMa systems are generally a few percent longer than the orbital period (Stolz and Schoembs, 1984), thus our light curve likely reflects the orbital period.

Table I.

UT(Geo) Aug.,1990	UV Per Δm	Check Δm
5.6551	5.22	5.01
5.6612	5.65	5.14
5.6673	5.53	4.97
5.6734	5.63	5.25
5.6796	5.52	5.25
5.6862	5.37	5.26
5.6924	5.32	5.27
5.6986	5.51	5.10
5.7049	5.15	5.25
5.7110	5.14	5.00
5.7171	5.46	5.10
5.7238	5.29	5.27
5.7303	5.49	5.09
5.7364	5.53	5.30
5.7490	5.47	5.17
5.7555	5.23	5.20
5.7616	5.31	5.38
5.7677	5.44	5.27
5.7738	5.30	5.19

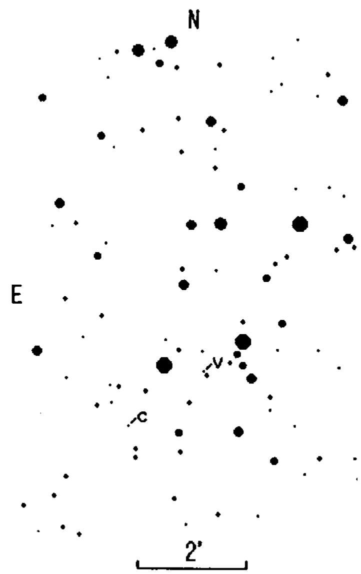


Figure 2.

TAICHI KATO

Dept. of Astronomy, Faculty of Science,
Kyoto University,
Sakyo-ku, Kyoto 606, Japan

References

Bruch, A., Fischer, F. J., and Wilmsen, U., 1987, *Astron. Astrophys. Suppl. Ser.* **70**, 481.
Stolz, B., and Schoembs, R., 1984, *Astron. Astrophys.* **132**, 187.
Szkody, P., 1985, *Astron. J.* **90**, 1837.
Udalski, A., and Mattei, J. A., 1989, IAU Circ. No. 4885.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3523

Konkoly Observatory
Budapest
5 October 1990

HU ISSN 0374 - 0676

B, V, R, I LIGHT CURVES OF V743 SAGITTARII AND ERRATA FOR EH HYDRAE

During recent observing runs at Cerro Tololo Inter-American Observatory we obtained complete precision light curves of several nondegenerate very short period eclipsing binaries. For most of these southern variables, such curves will represent the first complete photometric data published in the literature. Here we present B, V, R, I light curves of the thirteenth magnitude system, V743 Sgr (HV 10263), and correct some information previously given regarding EH Hya (Samec and Charlesworth 1990) which was observed as a part of the same program.

V743 Sagittarii

This variable was discovered by Swope (1940) in her examination of plates taken of the Harvard Milky Way field #189. Photographic light curves and a large scale finding chart are included in that publication. The ephemeris given by Swope is:

$$\text{JD Hel Min. I} = 2426564.21 + 0.276636 \cdot E\ .$$

A more useful 10' X 10' rendering of the field surrounding V743 Sgr (var. 109) has been published by Plaut (1958). Plaut calculated the improved ephemeris:

$$\text{JD Hel Min. I} = 2428094.2852 + 0.27663633 \cdot E\ .$$

Times of minimum light used in this calculation were determined from photographic plates taken by H. Van Gent. Later, in a search for eclipsing binaries in O-B associations, V743 Sgr was found to be in optical coincidence with the V Sgr association (Semeniuk 1962). Since no kinematical or spectroscopic data is available on the system Semeniuk was unable to confirm its membership.

The present observations of V743 Sgr were made on 8-11 May, 1989, inclusive. The Yale 1M Ritchey-Cretien Reflector Telescope was used. The photometry was done with B,V,R,I filters of the Johnson-Cousins' system using a dry-ice-cooled Hamamatsu R943-02 Ga-As photomultiplier tube in conjunction with the Automated Single Channel Aperture Photometer. The coordinates of the check, comparison and the variable star are given in Table 1. The comparison star is labeled "c" on the finding chart by Plaut (1958). Neither the check nor the comparison star was found to have a catalog

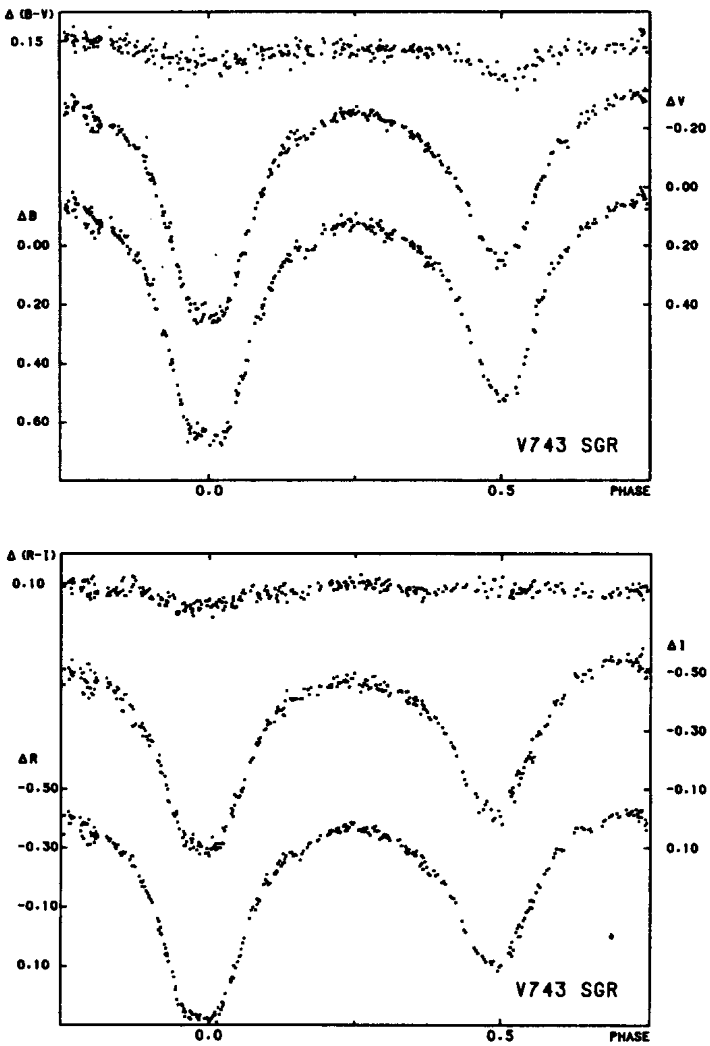


Fig. 1 - Light curves of V743 Sgr as defined by the individual observations.

TABLE 1

Star	R. A. (1900)	Dec. (1900)
V743 Sgr	$17^h\ 37^m\ 36^s$	-28° 26' 54"
Comparison	$17^h\ 37^m\ 47^s$	-28° 27' 22"
Check	$17^h\ 37^m\ 25^s$	-28° 28' 04"

identification. More than 325 observations were taken at each effective wavelength.

Four mean epochs of minimum light were determined from the observations made during two primary and two secondary eclipses. An iterative technique based on the Hertzsprung method (1928) was used to determine the timings except for the latest epoch in R and I. For these two values, the bisection-of-chords method was used. The times of minimum light are given in Table 2 along with the epochs determined by Swope (1940) and Plaut (1958). Probable errors are given in parentheses. These times of minimum light were introduced into a least squares solution to obtain both a linear and a quadratic ephemeris. They are:

$$\text{JD Hel Min. I} = 2447656.8517(5) + 0.27663567(1) \cdot E \quad \text{and,}$$

$$\text{JD Hel Min. I} = 2447656.8517(4) + 0.27663622(16) \cdot E - 0.000000000016(5) \cdot E^2$$

TABLE 2

JD HEL. 2400000+	Minimum	Cycles	$(O-C)_1$	$(O-C)_2$
26564.21	I	-76247.0	0.0000	0.0000
28094.2852	I	-70716.0	-0.0007	-0.0000
47655.8850(4)	II	-3.5	-0.0012	0.0015
47656.8517(1)	I	0.0	0.0010	-0.0000
47657.6810(1)	I	3.0	0.0009	-0.0006
47658.6489(8)	II	6.5	0.0001	-0.0009

The linear ephemeris was used to calculate the $(O-C)_1$ residuals in Table 2 and the phases of the present observations. The quadratic ephemeris was used to calculate the $(O-C)_2$ residuals, and the cycles.

The B, V, R, and I light curves of V743 Sgr defined by the individual observations are shown in Figure 1 as Δm versus phase. The analysis of the observations is underway.

EH Hydrae

The following table corrects Table 2 published earlier in IBVS No.3471 (Samec and Charlesworth 1990). The former results were in error by one JD.

TABLE 3

JD HEL. 2400000+	Minimum	Cycles	(O-C)
27870.515	II	-66640.5	0.0000
47654.6455(6)	I	-7.0	-0.0007
47655.5358(3)	I	-4.0	-0.0012
47655.6864(11)	II	-3.5	0.0010
47656.5770(8)	II	-0.5	0.0009
47656.7246(1)	I	0.0	0.0001

Also, the following improved ephemeris corrects the one given in the former publication:

$$\text{JD Hel Min. I} = 2447656.7246(3) + 0.29690968(1)^d \cdot E$$

RONALD G. SAMEC[a,b]
JASON R. DEWITT[b]

Dept. of Physics & Astronomy
J. I. Holcomb Observatory
Butler University
Indianapolis, IN 46208 USA

---

[a]Visiting Astronomer, Cerro Tololo Inter-American Observatory, National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc. under contract with the National Science Foundation.
[b]This research was supported by a grant from NASA administered by the American Astronomical Society and by 1988-89 and 1990-91 Butler Faculty and Student Fellowship Academic Grants.

References:

Plaut, L. (1958). Leid. Ann. 21(3), 217

Samec, R.G., and Charlesworth, S.D. 1990, I.B.V.S. No. 3471

Semeniuk, I. 1962, Acta Astron. 12(2).

Swope, H. H. (1940). Harvard Ann. 109(1)

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3524

Konkoly Observatory
Budapest
9 October 1990
HU ISSN 0374 - 0676

PHOTOELECTRIC PHOTOMETRY OF TZ BOÖTIS

The W UMa system, TZ Boötis, has exhibited several period changes since its discovery in 1926. The most recent change occurred during 1977-78, at which time the period suddenly shortened by 0.6 s (Gröbel, 1). Observations of period changes may help solve light curve irregularities in TZ Boötis as reported by Hoffmann (2, 3), and may increase our understanding of interactions between close binary systems.

BV differential photometry was conducted on TZ Boötis during two nights in April, 1989, with Lowell Observatory's 107 cm reflector on Anderson Mesa. Comparison stars were the same as used by Hoffmann (2). Primary (transit) minimum was observed on JD Hel 2447640.6925 ± 0.0005. Using Gröbel's (1) ephemeris of

$$\text{JD Hel Min}_{tr} = 2443655.5278 + 0.29715665\ E$$

for observations after JD 2443300 an O-C of -0.0031d was obtained. Thus, there is no evidence for a significant change in the period of TZ Boötis since 1978.

Hoffmann (3) found that the primary and secondary minima alternate in depth with a period of approximately 3.5 years. As can been seen in Fig. 1, the minima were nearly equal in depth with the primary minimum only slightly deeper than the secondary minimum. This is consistent with Hoffmann's prediction that the system should have been changing from a stage with a deep primary minimum (1988.8) to a stage with equal minima (1989.6).

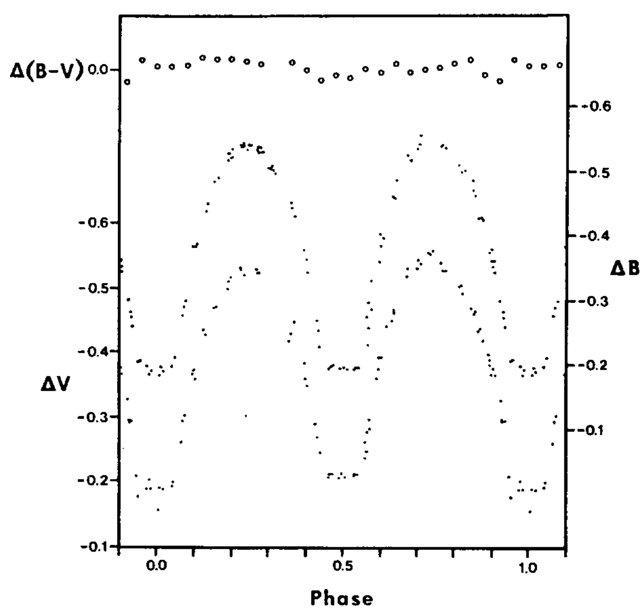


Fig. 1 B and V light curves of TZ Boötis, April 1989. The Δ(B − V) curve is based on normal points with bin widths of 0P.04.

The author is grateful to the Lowell Observatory for the use of its facilities, and is indebted to Tobias Kreidl and Andrew Odell for their encouragement and assistance.

DAVID SCHAUB
CBIS Federal Inc.
2255 N. Gemini Dr.
Flagstaff, Arizona 86001
USA

Visiting astronomer
Lowell Observatory
Flagstaff, Arizona
USA

References:

(1) Gröbel, R. : 1989, IBVS No. 3299
(2) Hoffmann, M. : 1978, Astron. Astrophys. Suppl. 33, 63
(3) Hoffmann, M. : 1980, Astron. AStrophys. Suppl. Ser. 40, 263

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3525

Konkoly Observatory
Budapest
10 October 1990

HU ISSN 0374 - 0676

VARIABILITY OF TWO SUPERGIANTS: HD 3940 AND HD 10494

Most of the supergiants show light and/or radial velocity variations (see e.g. Abt 1957, Rufener *et al.* 1978). The cause of the variation is probably pulsation (e.g. Maeder 1980, Lovy *et al.* 1984) though there are other suggestions (e.g. rotation, see Harmanec (1987)).

Two supergiants have been observed with the 1-m (during 1984–86) and 50-cm (during 1987–89) telescopes of Konkoly Observatory in Piszkéstető. The stars are HD 3940 (A1 Ia) and HD 10494 (F5 Ia). They are members of the associations Cas OB7 and Cas OB8, respectively (Humphreys 1978). Small amplitude radial velocity variations in HD 10494 were discovered by Smolinski *et al.* (1980).

HD 3940 was observed relative to BD+63°82, the check star was BD+63°87. The check−comparison difference in V is $0.^m756 \pm 0.^m013$. Only the V light curve is displayed in Figure 1 (together with the check star magnitudes), which shows that the mean V value of HD 3940 decreased by $0.^m15$ in three years. The $U-B$ curve follows the same pattern while the $B-V$ curve is its mirror image. A period of $9.^d7$ is expected from the *PLC* relation of Lovy *et al.* (1984), but neither this nor any other reasonable value could be derived from the data. The cause of the variation is unlikely to be pulsation, but there is insufficient information now even to guess its origin.

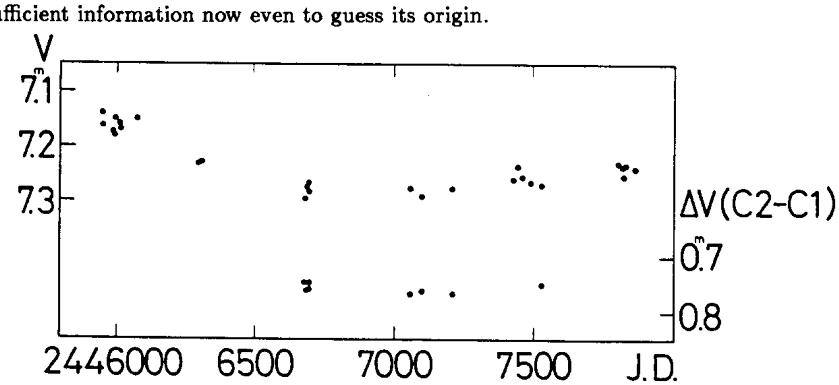


Figure 1

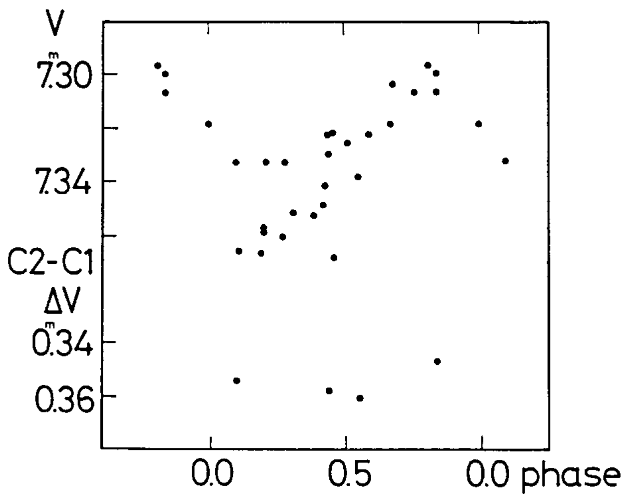


Figure 2

HD 10494 was observed relative to BD+60° 312, the check star was BD+60° 308. Their difference in V is $0.^{m}353 \pm 0.^{m}006$. Figure 2 is a plot of the V magnitudes of HD 10494 phased with a possible period of $12.^{d}7$. The amplitude is $0.^{m}05$ which is the expected value for an F5 supergiant (Maeder 1980). The amplitudes of the colour curves are negligible.

The period of the radial fundamental mode of an F5 supergiant is $39.^{d}8$ (using the $T_{\rm eff}$, M_V and B.C. values given by Humphreys (1978)), while the suggested period for HD 10494 is $12.^{d}7$. If this period is real, then it means that either the star pulsates in overtone or the cause of the variability is not pulsation.

No further observations are planned, the data are available upon request.

E. ZSOLDOS

Konkoly Observatory
Budapest XII. P.O. Box 67
1525 Hungary

References

Abt, H. A. 1957, *Astrophys. J.* **126**,138

Harmanec, P. 1987, *Bull. Astron. Inst. Czechosl.* **38**,52

Humphreys, R. M. 1978, *Astrophys. J. Suppl.* **38**,309

Lovy, D.; Maeder, A.; Noëls, A.; Gabriel, M. 1984, *Astron. Astrophys.* **133**,307

Maeder, A. 1980, *Astron. Astrophys.* **90**,311

Rufener, F.; Maeder, A.; Burki, G. 1978, *Astron. Astrophys. Suppl.* **31**,179

Smolinski, J.; Climenhaga, J. L.; Harris, B. L. 1980, *Acta Astron.* **30**,427

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3526

Konkoly Observatory
Budapest
15 October 1990

HU ISSN 0374 - 0676

UX ANTLIAE, UW CENTAURI AND RZ NORMAE AT MINIMUM BRIGHTNESS

UX Ant was considered a suspected member of the R Coronae Borealis (R CrB) type of variable stars (Erro, 1940; Kholopov, 1985), but recently Kilkenny suggested that it is a true member of the class (Kilkenny and Westerhuys, 1990). UW Cen and RZ Nor are true members of the class. Identification charts as well as other data on these stars may be found elsewhere (Milone, 1990a and 1990b).

UX Ant was monitored visually (0.20 and 0.25 m reflectors) by one of us (E.R.M.) from 1980 to 1982, and lately (less regularly) from 1986 up to the present, but only minor brightness variations were detected, usually amounting to not more than 0.2, or 0.3, of a magnitude (exceptionally, 0.5). However, from June 9.0 UT, 1990 on, a larger brightness decline has been observed (Minniti, 1990; Milone, 1990c). Also, in June 1990 our monitoring on UW Cen and RZ Nor showed that they were much fainter than normal.

As it was advisable to determine magnitudes on a well established system (e.g., UBV), plates of all the three variable star zones were obtained at Córdoba with the 0.33 m "Carte du Ciel" astrograph (plate scale 1 mm = 1'); Kodak 103 a-0 plates were used. The reason is that in our experience the Córdoba Observatory Gauthier astrograph used with Kodak-0 plates reproduced accurately the B magnitudes of the UBV system. To tie as closely as possible our derived magnitudes to the standard system, plates of the globular cluster NGC 5139 (Omega Cen) were obtained with the same instrument, taking care of observing at similar zenith distance, exposing equal times and developing all the plates simultaneously. In NGC 5139 a BV sequence reaching faint magnitudes was measured by Arp (Arp, 1958; Pisani Belserene, 1959). Thus we found that the limiting B magnitude in our astrographic plates for a 25 minute exposure is 17.4.

Twenty two B plates were used in the following discussion: UX Ant 3, UW Cen 6, RZ Nor 6 and Omega Cen 7. They range in time from 1968 up to the present.

UX Ant was found at $16\overset{m}{.}9$ on July 25.0 UT (JD 2448097.5), and fainter than $17^{m}.4$ on July 27.0 (JD 2448099.5). Kholopov (1985) indicates $12^{m}.2$ and $15^{m}.8$, photographic, for the maximum and faintest brightness of this star; these values were traceable to the discoverer of the variable (Erro, 1940). From our plates we find: maximum, $12^{m}.6$ (May 7.1, 1975, JD 2442539.6), minimum, $< 17^{m}.4$ (B magnitudes). If we adopt (B-V) = $0^{m}.6$ (Kilkenny and Westerhuys, 1990), the maximum V magnitude would be V=12.0, but as very probably (B-V) would fluctuate (being as large as $0^{m}.8$, or $1^{m}.0$, for a giant star whose peculiar spectral type may be around G5 (Allen, 1976)), it is safer to say that at maximum UX Ant would have $11^{m}.5 \lessapprox V \lessapprox 12^{m}.0$. UX Ant shows a nearly constant maximum light only affected by small and irregular fluctuations, and sudden and irregular drops in brightness as large as, or larger than 4 magnitudes, this behaviour closely resembles that shown by other typical R CrB stars, and on this basis it can be suggested that it is a true R CrB star (for a description of the spectral characteristics also sustaining that it is a true R CrB star, see Kilkenny and Westerhuys, 1990). Finally, it is worth mentioning that a near-by star (B=$16^{m}.5$, 15 arc seconds to the NW of UX Ant) may be confused with the variable when it becomes fainter than $16^{m}.5$.

UW Cen has been fainter than normal since January 1988. A near-by star (B=$14^{m}.1$, 20 or 25 arc seconds to the NNW of the variable) has been frequently confused with it when it becomes fainter than $14^{m}.0$. UW Cen was found at $17^{m}.2$ on June 12.0, 1990 (JD 2448054.5) and $17^{m}.4$ on July 24.0 (B magnitudes). On June 21.0 and July 17.0, 1990, the star was invisible when observing visually its field with the 60 inch reflector of the Bosque Alegre Station (branch of the Córdoba Astronomical Observatory); according to Schaefer (1990), the limiting visual magnitude of such an instrument would be around $16^{m}.5$. If we accept for this star a (B-V) $\underset{\sim}{\sim}$ $1^{m}.0$, it means that it was fainter than B=$17^{m}.5$ on June 21 and July 17, a value very near coincidental with that derived photographically. Kholopov (1985) indicates for the maximum and minimum brightness of this star $9^{m}.1$ and $< 14^{m}.5$, V; we found, maximum, $10^{m}.5$ (May 7.2, 1975, JD 2442539.7), minimum, $17^{m}.4$ (B magnitudes, from the previously adopted (B-V) $\simeq$ 1.0 a maximum V $\simeq$ 9.5 is derived). On plates taken in 1990, August 18.0 and 20.0 with the 60 inch reflector (Kodak 103 a-0 plates + GG 13 filter, processed as previously described) UW Cen was found at B=16.4 and 16.0, respectively, so it seems that the star was recovering its brightness.

RZ Nor also has a close companion (B=13.7, 8 arc seconds to the NE of the variable; for details see Milone, 1990b) which may be confused with it when it becomes fainter than $13^{m}.5$. RZ Nor was found to be fainter than $17^{m}.4$

on June 17.1, 1990 (JD 2448059.6), and at $17^{m}.4$ on July 24.1; it was invisible to the eye when observing its field with the 60 inch reflector on July 13.1, 1990 and was found recovering with magnitude B=15.2 on plates taken with the same instrument on August 18.1 and 20.1, 1990 (around magnitude 13, visual, on September 9.5). Kholopov (1985) indicates $10^{m}.6$ and $<13^{m}$, V, for maximum and minimum brightness; we found, $11^{m}.5$ (August 10.0, 1988, JD 2447383.5) and $<17^{m}.4$ (B magnitudes, for (B-V) $\simeq$ 1.0, a maximum light V $\simeq$ 10.5 is derived.

Many thanks to MM. Z. M. Pereyra and J.J. Rodriguez for kindly obtaining several plates for us with the 60 inch reflector of the Bosque Alegre Station and to Mr. R.H. Tschamler for idiomatic corrections. A grant from CONICOR, Córdoba, Argentina, partially supporting this research is acknowledged.

L.A. MILONE	E.R. MINNITI	S. PAOLANTONIO
Obs. Astronomico Univ. Nac. De Córdoba Córdoba, Argentina	Atel Santa Fe Argentina	Atel Santa Fe Argentina

References:

Allen, C.W.: 1976, Astrophysical Quantities, 3rd. edition, Univ. of London, The Athlone Press, London, pg.206.
Arp, H.C.: 1958, Astron. J. 63, 118.
Erro, L.E.: 1940, Harvard College Obs. Bull., No.913, 1.
Kholopov, P.N. (Editor in Chief): 1985, General Catalogue of Variable Stars, 4th. ed., vol. I and II, Astronomical Council of the Academy of Sciences of the USSR, Moscow.
Kilkenny, D., Westerhuys, J.E.: 1990, The Observatory, 110, 90.
Milone, L.A.: 1990a, "Identification charts for southern R Coronae Borealis Stars", Ap. and Sp. Science (in press),
1990b, "The position of RZ Normae", I.B.V.S. No.3505.
1990c, IAU Circular, No.5089.
Minniti, E.R.: 1990, IAU Circular, No.5058.
Pisani Belserene, E.: 1959, Astron. J., 64, 58.
Schaefer, B.E.: 1990, Publ. Astron. Soc. Pacific, 102, 212.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3527

Konkoly Observatory
Budapest
16 October 1990
HU ISSN 0374 - 0676

NEW PHOTOELECTRIC MINIMA TIMES OF TZ DRACONIS AND ITS PERIOD STUDY

The eclipsing binary star TZ Dra (BD +47° 2625 (Faulkner, 1986)) has been observed photoelectrically from the National Observatory of Athens, Greece, during 1983. The observations were made using a two-beam, multi-mode, nebular-stellar photometer attached to the 48-inches Cassegrain reflector at the Kryonerion Astronomical Station.

The stars HD 170074 (of m_v=9.0) and HD 170357 (of m_v=8.31) were used for comparison and checking, respectively. The two intermediate pass bands of the filters used are in close accordance to the international UBV system and the photometer was cooled using dry ice. Reduction of the observations has been made (Hardie, 1962) as usual.

From our observations 4 new minima times (three primaries and one secondary) were derived. They were found using Kwee and Van Woerden's method (1956) and are the mean values of our B and V observations. They are presented in Table I the successive columns of which give: the Hel. JD; the residuals $(O-C)_I$, $(O-C)_{II}$ and $(O-C)_{III}$; and the corresponding number of cycles passed, E_I, E_{II} and E_{III}. The C's have been calculated using the three different proposed ephemeris formulae for TZ Draconis, which are:

$$\text{Min I} = 2433871.389 + 0^{d}.8660337\ E \qquad \text{(I)}$$

(due to Perova, 1952)

$$\text{Min I} = 2437911.4347 + 0^{d}.8660333\ E \qquad \text{(II)}$$

(due to Plavec, 1964)

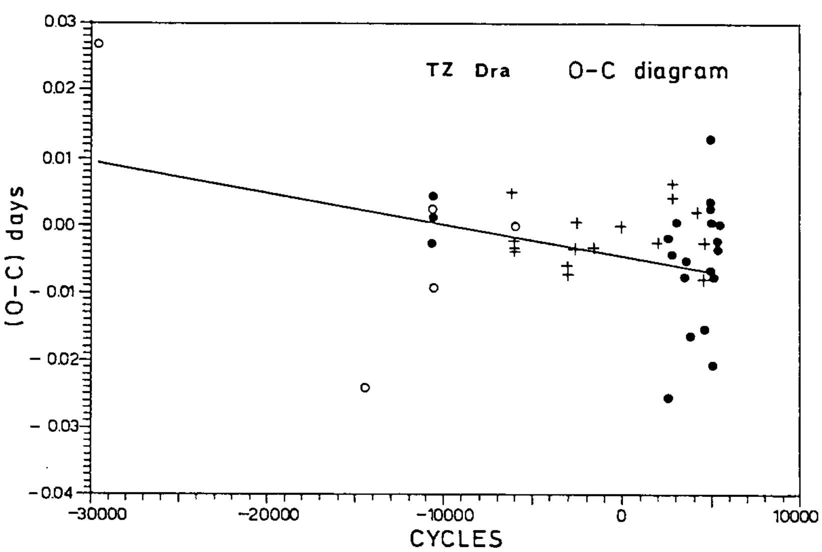


Figure 1 The O-C diagram of TZ Dra based on primary minima times only and according to Kholopov's et al. (1985) ephemeris formula. (Notations: Open circles (o) represent the photographic minima times, crosses (+) the photoelectric and filled circles (•) the visual ones.

and

$$\text{Min I} = 2442966.482 + 0^{d}.8660347\ E \qquad \text{(III)}$$

(Kholopov et al., 1985)

TABLE I

(New Photoelectric Minima Times of TZ Draconis)

Hel. JD 2440000.+	$(O-C)_{I}$ days	E_{I}	$(O-C)_{II}$ days	E_{II}	$(O-C)_{III}$ days	E_{III}
5488.3792	.0141	13414	.0192	8749	.0042	2912
5495.3097	.0164	13422	.0214	8757	.0064	2920
5497.4786	.0202	13424.5	.0252	8759.5	.0102	2922.5
5585.3717	.0109	13526	.0159	8861	.0008	3024

From all the minima times of TZ Dra found in the literature, Table II was made, in which the (O-C) values have been calculated using Kholopov's et al. (1985) ephemeris formula. Using the data of Tables I and II, the figure 1 was drown, which represents the O-C diagram of TZ Draconis, in which crosses denote the photoelectric minima times, open circles the photographic and filled circles the visual ones. From the data of Table I only the three primaries have been taken into account, since the system appears to have an eccentric orbit. As one can see from Figure 1, a linear least square fitting to all the data shows a small change in the period of TZ Dra, but since almost all the minima times (with the exception of the first two and some visual) lay arround zero this must not be true.

TABLE II
Minima Times of TZ Draconis
(According to Kholopov's et al. ephemeris formula)

Hel. JD 2400000.+	$(O-C)_{III}$ days	E_{III}	**Obs.** Kind	**Reference**
17445.332	0.027	-29469	pg	Plavec, 1964
30588.272	-0.024	-14293	pg	"
3852.339	0.006	-10524	pg	"
3864.460	0.003	-10510	v	"
3865.320	-0.003	-10509	v	"
3871.390	0.005	-10502	v	"
3884.367	-0.009	-10487	pg	"
3950.196	0.001	-6024	pg	"
7840.4202	-0.0024	-5919	pe	"
7866.3999	-0.0038	-5889	pe	"
7897.5771	-0.0038	-5853	pe	"
7905.3730	-0.0022	-5844	pe	"
7911.4342	-0.0033	-5837	pe	"
7911.4353	-0.0022	-5837	pe	"
40394.353	-0.006	-2970	pe	Pohl et al., 1970
0419.4667	-0.0072	-2941	pe	"
0814.3824	-0.0034	-2485	pe	Kizilirmak et al.,1971
0852.492	0.001	-2441	pe	"
1519.3351	-0.0029	-1671	pe	Kizilirmak et al.,1974
2966.4820	0.0000	0	pe	Pohl et al., 1977
4770.4300	-0.0023	2083	v	BBSAG No. 55,1981
5223.3430	-0.0254	2606	v	BBSAG No. 62, 1982
5275.3290	-0.0015	2666	v	BBSAG No. 64, 1983

TABLE II (cont.)

Hel. JD 2400000.+	(O-C)xxx days	Exxx	Obs. Kind	Reference
45478.8447	-0.0040	2901	pe	Faulkner, 1986
6335.341	-0.016	3890	v	BBSAG No. 78, 1985
6657.523	0.002	4262	v	BBSAG No. 81, 1986
6962.349	-0.015	4614	v	BBSAG No. 84, 1987
6981.411	-0.008	4636	v	"
7000.469	-0.003	4658	v	BBSAG No. 86, 1988
7324.372	0.003	5032	v	BBSAG No. 88, 1988
7330.424	-0.007	5039	v	BBSAG No. 89, 1988
7362.474	0.000	5076	v	"
7369.404	0.002	5084	v	"
7382.377	-0.016	5099	v	"
7467.276	0.012	5197	v	BBSAG No. 90, 1989
7480.247	-0.008	5212	v	"
7757.383	-0.003	5532	v	BBSAG No. 92, 1989
7770.372	-0.004	5547	v	"
7816.275	-0.001	5600	v	BBSAG No. 93, 1990

H. ROVITHIS-LIVANIOU

Section of Astrophysics
Astronomy and Mechanics
Athens University
GR 157 83 Zografos, Athens, Greece

P. ROVITHIS

Astronomical Institute
National Observatory of
Athens, P.O. Box 20048
Athens 118 10, Greece

References:

Faulkner, D.R.: 1986, Publ. Astron. Soc. Pacific 98, 690.

Hardie, R.H.: 1962, in W.A. Hiltner (ed.), Stars and Stellar Systems Vol. II, Astronomical Techniques, The University of Chicago Press, Chicago.

Kholopov, P.N. et al.: 1985, Fourth Edition of the General Catalogue of Variable Stars, Moscow.

Kizilirmak, A. and Pohl, E.: 1971, I.B.V.S. No. 530.

Kizilirmak, A. and Pohl, E.: 1974, I.B.V.S. No. 937.

Kwee, K.K. and Van Woerden, H.: 1956, Bull. Astron. Inst. Neth. 12, 327.

Perova,N. B.: 1952, Peremennyje Zvezdy 9, 142.

Plavec,M.: 1964, Bull. Astron. Inst. Ch. 15, 23.

Pohl, E. and Kizilirmak, A.: 1970, I.B.V.S. No. 456.

Pohl, E. and Kizilirmak, A.: 1977, I.B.V.S. No. 1358.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3528

Konkoly Observatory
Budapest
16 October 1990

HU ISSN 0374 - 0676

PHOTOELECTRIC MINIMA TIMES OF GK CEPHEI AND VARIATIONS IN ITS PERIOD

The eclipsing binary star GK Cep (BV 382 , BD+70° 1183, HD 205372, SAO 10069) has been observed photoelectrically during 1987 and 1988 from the National Observatory of Athens, Greece. The observations were made with a two-beam, multi-mode, nebular-stellar photometer attached to the 48-inches Cassegrain reflector at the Kryonerion Astronomical Station.

Reduction of the observations has been made as usual (Hardie, 1962) and the pass bands of the B and V filters used are in close accordance to the standard ones. The stars HD 205328 and HD 205284 were used for comparison and checking, respectively.

From our observations of GK Cep eleven new minima times (8 primaries and 3 secondaries) were derived using Kwee and Van Woerden's (1956) method and are the mean values of B and V colours. They are given in Table I, the successive columns of which give: the Hel. JD, the differences $(O-C)_I$ and $(O-C)_{II}$, the minimum type and the number N of the observed points.

In the residuals $(O-C)_I$ and $(O-C)_{II}$ the C's have been calculated using the following ephemeris formulae, respectively:

(I): Min I=2438694.7063+0^d.936157.E
(due to Dworak, 1975)

and

(II): Min I=2438694.683+0^d.9361669.E
(Krakow No.57,1986)

TABLE I

(New photoelectric minima times of GK Cephei)

Hel.JD 2440000.+	$(O-C)_I$ days	$(O-C)_{II}$ days	Min Type	N
7063.5472	0.0654	0.0002	II	13
7064.4828	0.0678	-0.0004	II	18
7065.4193	0.0652	0.0000	II	17
7335.5029	0.0675	-0.0006	I	18
7449.5456	0.0678	-0.0004	I	18
7350.4812	0.0673	-0.0010	I	21
7351.4189	0.0688	0.0006	I	21
7394.4846	0.0713	0.0026	I	26
7395.4176	0.0671	-0.0006	I	31
7396.3564	0.0708	0.0023	I	31
7397.2882	0.0664	-0.0023	I	22

As is obvious from the (O-C) values presented in Table I, the period of GK Cep has changed and we tried to find out how this happened. Thus, from all the minima times of GK Cep found in the literature, Table II was made, the successive columns of which give: the Hel. JD; the residuals $(O-C)_I$, in

TABLE II
(Minima Times of GK Cephei, found in the literature)

Hel.JD 2430000.+	(O-C)$_I$ days	E	Min Type	Obs. Kind	References
8606.7068	+0.0007	-94	I	pe	Ruiz et al. 1967
8622.636	+0.014	-77	I	pe	"
8627.7712	-0.0054	-71.5	II	pe	Gleim,1967
8634.795	+0.003	-64	I	pe	Ruiz et al. 1967
8642.759	+0.004	-55.5	II	pe	"
8644.635	+0.008	-53.5	II	pe	"
8649.757	-0.014	-48	I	pe	"
8652.585	+0.006	-45.	I	pe	"
8652.588	+0.009	-45	I	pe	"
8694.7047	-0.0016	0	I	pe	"
8694.7070	+0.0007	0	I	pe	Gleim,1967
8700.7885	-0.0083	6.5	II	pe	Ruiz et al. 1967
8703.6015	-0.0038	9.5	II	pe	"
8708.7487	-0.0001	15	I	pe	"
8709.6866	+0.0018	16	I	pe	Gleim,1967
8711.5587	+0.0016	18	I	pe	Ruiz et al. 1987
8731.6864	-0.0034	39.5	II	pe	Gleim,1967
8748.5433	+0.0025	57.5	II	pe	"
8997.0911	+0.0061	323	I	pe	Ruiz et al. 1967
8997.5592	+0.0006	323.5	II	pe	"
9405.7367	+0.0137	759.5	II	pe	"
2440000.+					
0532.3881	+0.0056	1963	I	pe	Dworak,1975
0532.3883	+0.0058	1963	I	pe	"
0542.2229	+0.0053	1973.5	II	pe	"
0542.2237	+0.0061	1973.5	II	pe	"
0845.5325	0.0000	2297.5	II	pe	"
0845.5327	+0.0002	2297.5	II	pe	"
0852.5476	-0.0006	2305	I	pe	"
0852.5488	+0.0006	2305	I	pe	"
0867.5257	-0.0010	2321	I	pe	"
0867.5265	-0.0002	2321	I	pe	"
0868.4625	-0.0003	2322	I	pe	"
0868.4632	+0.0004	2322	I	pe	"
0869.3972	-0.0018	2323	I	pe	"
0869.3976	-0.0014	2323	I	pe	"
0870.3347	-0.0005	2324	I	pe	Gleim,1967
0870.3353	+0.0001	2324	I	pe	"
0876.4243	-0.0014	2330.5	II	pe	"
0876.4247	-0.0010	2330.5	II	pe	"
1080.5062	-0.0017	2548.5	II	pe	"
1080.5082	+0.0003	2548.5	II	pe	"
1964.9191	+0.0034	3474	I	pe	Isles,1985
2685.5421	+0.0025	4261	I	pe	Dworak,1976
3068.446	+0.0142	4672	I	v	BBSAG No.31,1977
3069.388	+0.0200	4673	I	v	"
3090.446	+0.0145	4695.5	II	v	"
3098.400	+0.0112	4704	I	v	"
3099.338	+0.0130	4705	I	v	"
3100.279	+0.0189	4706	I	v	"
3106.366	+0.0188	4712.5	II	v	BBSAG No.32,1977
3107.302	+0.0198	4713.5	II	v	BBSAG No.31,1977

Cont. of Table II

Hel. JD 2440000.+	(O-C)$_I$ days	E	Min Type	Obs. Kind	References
3159.246	+0.0070	4769	I	v	BBSAG No.32,1977
3173.283	+0.0016	4784	I	v	"
3369.398**	-0.0163**	4993.5	II	v	BBSAG No.37,1978
3392.362*	+0.0199	5018 *	II*	v	"
3399.375	+0.0117	5025.5	II	v	"
3464.439	+0.0128	5095	I	v	BBSAG No.35,1977
3488.314**	-0.0204**	5121.5	II	v	BBSAG No.36,1978
3517.327	+0.0079	5151.5	II	v	"
3589.399*	-0.0042	5228.5*	I *	v	BBSAG No.38,1978
3590.360*	+0.0207	5229.5*	I *	v	"
4937.516	+0.047	6668.5	II	pe	Isles,1985
5671.4680	+0.0517	7452.5	II	pe	"
5890.536	+0.0589	7686.5	II	v	BBSAG No.73,1984
6162.4943	+0.0636	7977	I	pe	Isles,1985
6236.383	-0.0041	8056	I	v	BBSAG No.77,1985
6279.450	-0.0003	8102	I	v	"
6287.4712	+0.0635	8110.5	II	pe	Pohl et al. 1987
6311.3413	+0.0616	8136	I	pe	"
6318.3636	+0.0636	8143.5	II	pe	"
6325.3847	+0.0627	8151	I	pe	"
6332.4057	+0.0625	8158.5	II	pe	"
6339.4287	+0.0643	8166	I	pe	"
6691.4264	+0.0670	8542	I	pe	"
7695.453	+0.065	9614.5	II	pe	BBSAG No.93,1990
7804.444**	-0.0061**	9731	I	v	"
7805.387**	+0.0008**	9732	I	v	"

Notations:

* They found to be of different type than that reported in the reference

** They haven't taken into account in the diagrams 1,2 and 3 since their (O-C) values deviate too much from the others.

which the C's have been calculated using ephemeris formula given by the foregoing equation (I); the number E of the cycles passed; the minimum type; the kind of observation and the reference.

From the data presented in Table II, three visual minima types must be of different kind than that referred in the literature, as the number E of the cycles passed indicates. These, have been marked with an asterisk. Moreover, there are four visual minima times, marked with two asterisks, in which the (O-C)$_I$ values deviate too much from all the others and they haven't been taken into account.

From the data of Tables I and II, the diagrams, 1,2 and 3 were drawn, in which linear-linear, linear-quadratic and quadratic least square fitting has been achieved, respectively, and where crosses denote the photoelectric minima times, while squares the visual ones.

Unfortunately, there are not observed minima times for GK Cep from JD 2443000 till 2445000, and from the visual ones which cover only the interval from JD 2443100 till 2443900, two have not taken into account, since they deviate.

As one can see from the diagrams 1,2 and 3 the period of GK Cep from JD. 2438000 till 2443000 was almost constant, but after that it seems that there is a jump. More observations of

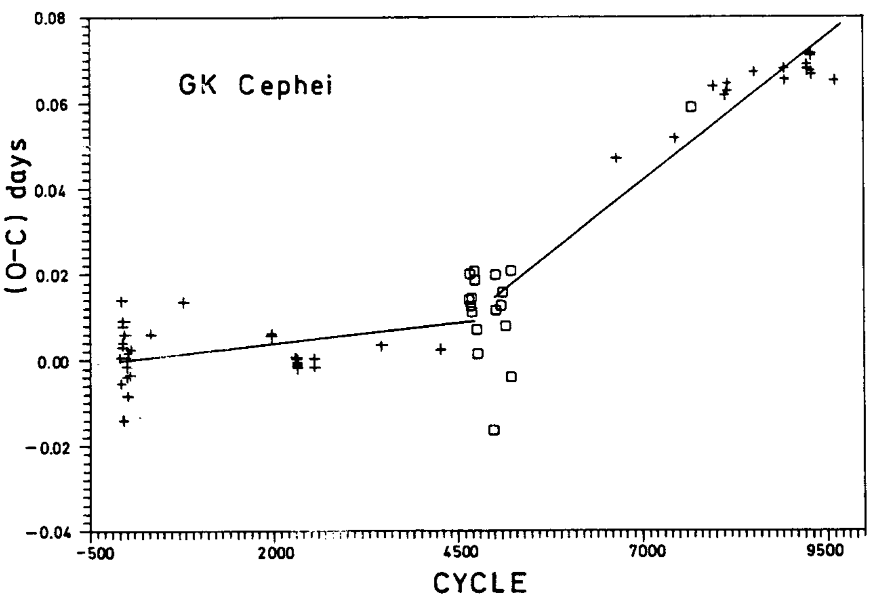


Figure 1 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Linear-linear least squares fitting.

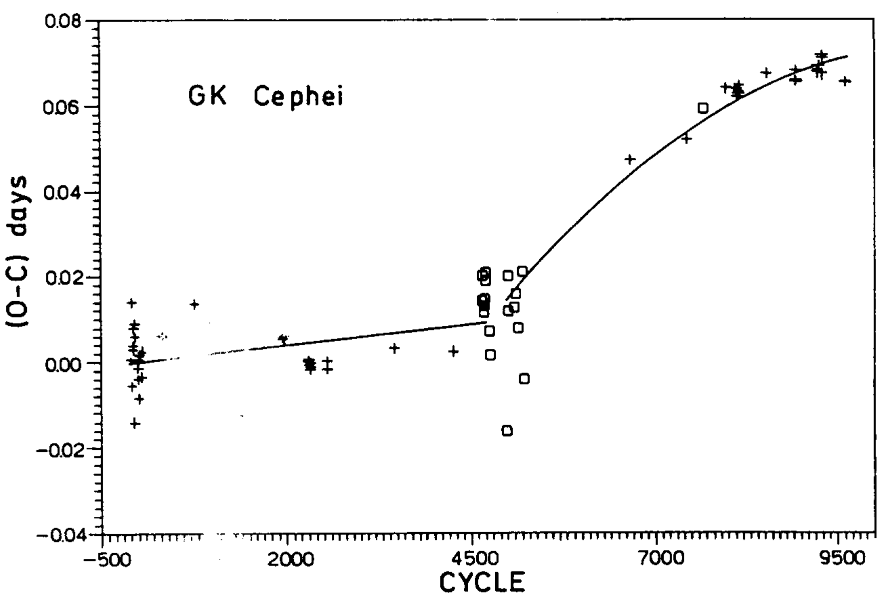


Figure 2 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Linear-quadratic least squares fitting.

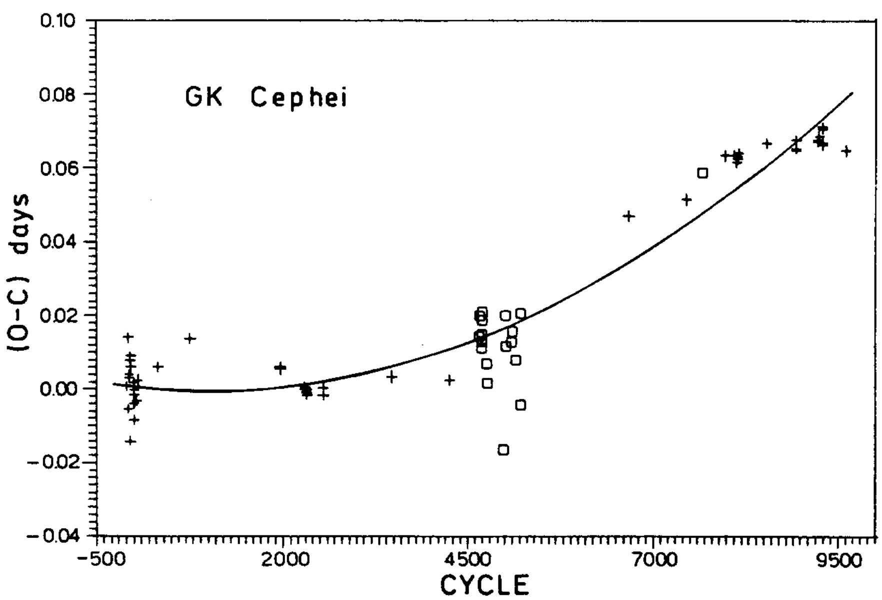


Figure 3 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Quadratic least squares fitting.

its minima time are needed to see if this period increasing will be continued.

H. ROVITHIS-LIVANIOU and
P.G. NIARCHOS
Section of Astrophysics
Astronomy and Mechanics
Athens University
GR 157 83 Zografos
Athens, Greece.

P. ROVITHIS and
A. KALIMERIS
Astronomical Institute
National Observatory of
Athens, P.O. Box 20048
Athens 118 10, Greece.

References

Dworak, T.Z.: 1975, Acta Astron, 25, 103.

Dworak, T.Z.: 1976, I.B.V.S. No. 1081.

Gleim, J.K. : 1967 Astron. J. 72, 510.

Hardie, R.H.: 1962, in W.A. Hiltner (ed.), Stars and Stellar Systems Vol. II, Astronomical Techniques, The University of Chicago Press, Chicago.

Isles, J.E.: 1985, I.B.V.S. No. 2741.

Kwee, K.K. and Van Woerden, H.: 1956, Bull. Astron.Inst. Neth.12, 327.

Rocznik Astronomiczny Observatorium Krakowskiego, No. 57, p.100, Krakow, 1986.

Ruiz,J.J. and Stokes,A. : 1967, I.B.V.S. No. 180.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3529

Konkoly Observatory
Budapest
24 October 1990

HU ISSN 0374 - 0676

PHOTOMETRIC PERIODICITY OF V404 Cyg(=GS2023+338)

V404 Cyg is the optical counterpart of the X-ray transient source GS2023+338, a black hole candidate. Howell and Shafter (1990) recently determined the spectroscopic orbital period as 0.207 ± 0.015 days. However relatively large uncertainty remained because their observations did not cover the full orbital cycle. We here present an independent detection of photometric periodicity by the CCD photometry.

Our observations were done with Thomson CCD (576×384 pixels, on chip summation of 2×2 pixels) attached to the Cassegrain focus of the 60cm reflector at the Ouda Station on August 6 and 7, 1990. The Kron I filter (λeff=780nm, FWHM=156nm) was employed and the exposure time was 60 seconds in most cases, but was 120 seconds during the partial lunar eclipse on August 6.

The frames were processed with the point spread function photometry package developed by the author (TK). The processed image was shown in Figure 2. The magnitudes of the variable (V) and the check star (ch) were determined relative to the comparison star (C), which were then time-averaged to 0.01 day bins.

The results are shown in Table 1 and Figure 1. Table 1 includes the date of observation, the differential magnitude, Δm, the standard deviation, SD, and the number of frames averaged, n. The light curve on August 6 displays almost sinusoidal variation with an amplitude of 0.22 magnitude (figure 1). We could not detect neither flaring variation, which was seen during the outbursting phase (Wagner et al. 1989), nor evident eclipses. The least-squares fit to the sine function yields a period of 0.240 days, with an uncertainty of 0.008 days. During a short observation run on August 7, the variable was roughly constant at about 0.1 mag. brighter than the minimum magnitude in the previous night. This observation was not used to improve the period because of shortness of the run and the possible existence of night-to-night variation of the mean brightness.

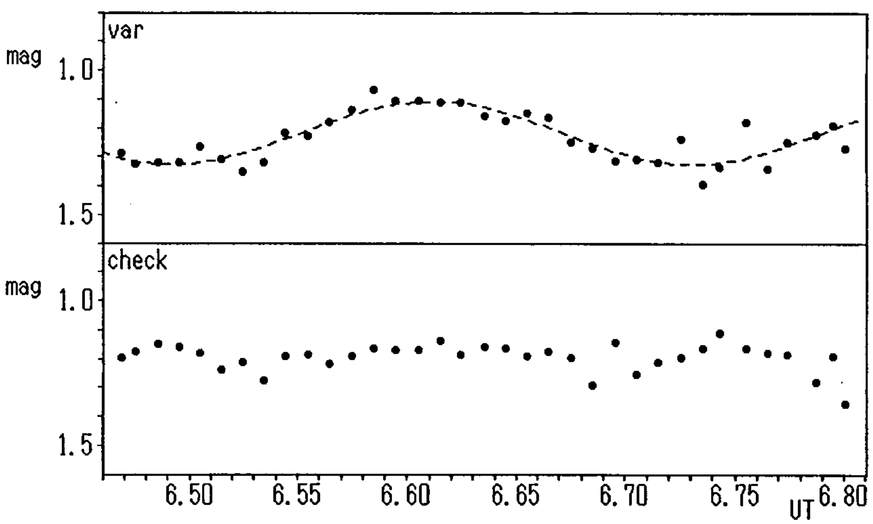
This periodic modulation of brightness may be interpreted as (a) ellipsoidal variation of the distorted secondary as in V616 Mon (McClintock and Remillard, 1986), (b) reflection effect of the heated secondary, and (c) changing aspect of the accretion disk or the hot spot, including partial obscuration of the accretion disk by the extended disk structure. The interpretation (a) will be rejected if the spectroscopic period actually represents the orbital period. In this case the photometric period must be the half of the orbital one. The cases (b) and (c) are more likely in this respect. The orbital inclination of the system was suggested to be low on account of the narrowness of the emission lines (Wagner and Starrfield, 1989). The small K_2-velocity of $74 \pm 9 km/s$ (Howell and Shafter, 1990) also seems to support it. However, rapid X-ray variability caused by variable obscuration (Makino and the Ginga Team, 1989) implies a high inclination (Charles et al., 1990). Our photometric amplitude may offer an additional information on the orbital inclination.

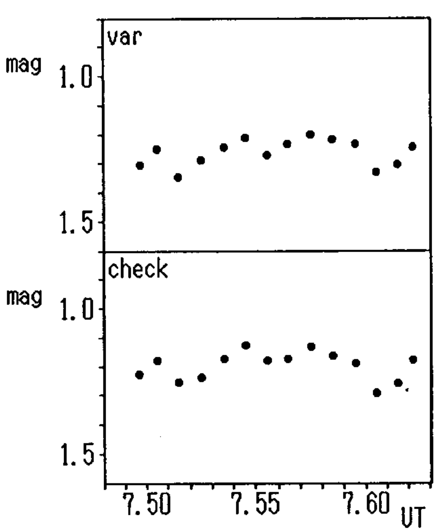
Significant difference between the spectroscopic and the photometric periods may lead to an idea that these two periods are essentially different, as observed as the superhumps of the SU UMa systems or the beat periods of the intermediate polars. In these cases, high orbital inclination is not necessary. In the cases (b) and (c), the amplitude of the variability may be variable, because the heating of the secondary may be changing as suggested by Howell and Shafter (1990). Further spectroscopic and multi-wavelength observations are required to improve the period as well as to check the stability of the light curve.

Table I.

	V404 Cyg				Check		
UT(Geo) Aug.,1990	Δm	SD	n	UT(Geo) Aug.,1990	Δm	SD	n
6.4685	1.29	0.12	3	6.4685	1.20	0.03	3
6.4752	1.33	0.08	10	6.4752	1.17	0.10	10
6.4854	1.32	0.13	9	6.4858	1.15	0.11	8
6.4950	1.32	0.10	9	6.4950	1.16	0.12	9
6.5051	1.27	0.06	10	6.5051	1.18	0.12	10
6.5148	1.31	0.09	9	6.5148	1.24	0.09	9
6.5250	1.35	0.05	10	6.5250	1.21	0.10	10
6.5347	1.32	0.10	9	6.5347	1.28	0.08	9
6.5447	1.22	0.05	10	6.5447	1.19	0.06	10
6.5551	1.23	0.05	10	6.5551	1.19	0.04	10
6.5649	1.18	0.05	9	6.5649	1.22	0.04	9
6.5750	1.14	0.03	10	6.5750	1.19	0.08	10
6.5849	1.07	0.03	5	6.5849	1.16	0.06	5
6.5950	1.11	0.05	6	6.5950	1.17	0.05	6
6.6055	1.11	0.06	6	6.6055	1.17	0.05	6
6.6149	1.11	0.05	4	6.6149	1.14	0.04	4
6.6245	1.11	0.04	6	6.6245	1.19	0.04	6
6.6351	1.16	0.03	6	6.6351	1.16	0.05	6
6.6455	1.18	0.04	6	6.6455	1.17	0.06	6
6.6548	1.15	0.09	10	6.6548	1.19	0.08	10
6.6648	1.17	0.07	10	6.6648	1.18	0.13	10
6.6751	1.25	0.10	10	6.6751	1.20	0.11	10
6.6849	1.27	0.05	9	6.6849	1.29	0.11	9
6.6952	1.32	0.10	8	6.6952	1.15	0.05	8
6.7052	1.31	0.08	10	6.7052	1.26	0.08	10
6.7153	1.32	0.08	10	6.7153	1.21	0.10	10
6.7255	1.24	0.10	10	6.7255	1.20	0.17	10
6.7351	1.40	0.10	9	6.7351	1.16	0.13	9
6.7433	1.34	0.11	6	6.7433	1.11	0.12	6
6.7550	1.18	0.13	9	6.7550	1.16	0.17	9
6.7649	1.34	0.12	9	6.7645	1.18	0.13	10
6.7738	1.25	0.05	8	6.7738	1.19	0.06	8
6.7872	1.23	0.09	5	6.7872	1.28	0.06	5
6.7949	1.19	0.09	9	6.7946	1.19	0.14	10
6.8007	1.27	0.09	2	6.8007	1.36	0.07	2
7.4972	1.30	0.12	5	7.4965	1.23	0.04	6
7.5051	1.25	0.08	7	7.5051	1.18	0.05	7
7.5149	1.35	0.10	7	7.5149	1.25	0.09	7
7.5251	1.29	0.08	8	7.5251	1.24	0.06	8
7.5356	1.25	0.04	7	7.5356	1.17	0.06	7
7.5456	1.22	0.05	7	7.5456	1.13	0.06	7
7.5550	1.27	0.08	7	7.5550	1.18	0.06	7
7.5644	1.23	0.10	7	7.5644	1.18	0.10	7
7.5750	1.20	0.05	8	7.5750	1.13	0.06	8
7.5845	1.22	0.04	6	7.5845	1.17	0.03	6
7.5952	1.23	0.06	8	7.5952	1.19	0.10	8
7.6050	1.33	0.05	2	7.6050	1.29	0.08	2
7.6147	1.30	0.09	8	7.6147	1.26	0.04	8
7.6221	1.25	0.03	3	7.6221	1.18	0.04	3

August 6, 1990.





August 7, 1990.

Figure 1.

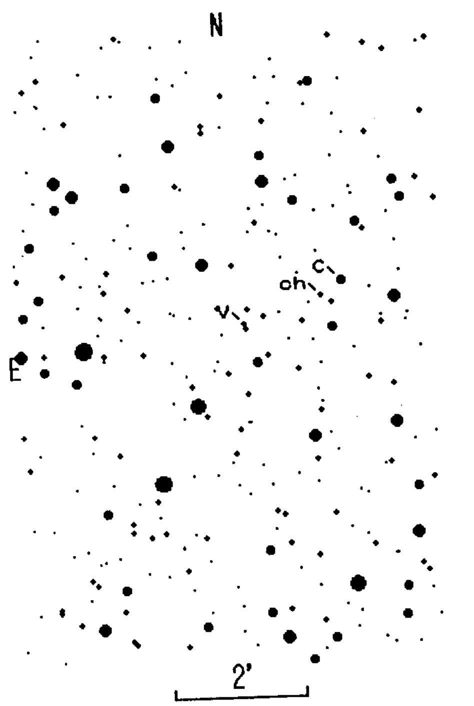


Figure 2.

TAICHI KATO RYUKO HIRATA

Dept. of Astronomy, Faculty of Science,
Kyoto University,
Sakyo-ku, Kyoto 606, Japan

References

Charles, P. A., Casares, J., Jones, D. H. P., Broadhurst, T., Callanan, P. J., Carter, D., Hacking, P., Hassall. B. J. M., Lawrence, A., Naylor, T., Rutten, R. G. M., Sahu, K. C., and Taylor, A., 1990, Royal Greenwich Observatory preprint No. 120. (paper given at 23rd ESLAB symposium on X-ray Astronomy).
Howell, C. A., Shafter, A. W., 1990, IAU Circ. No. 5074.
Makino, F., and the Ginga Team, 1989, IAU Circ. No. 4782.
McClintock, J. E., Remillard, R. A., 1986, Ap. J., **308**, 110.
Wagner, R. M., and Starrfield, S. G., 1989, IAU Circ. No. 4786.
Wagner, R. M., and Starrfield, S. G., and Cassatella, A., 1989, IAU Circ. No. 4783.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3530

Konkoly Observatory
Budapest
24 October 1990

HU ISSN 0374 - 0676

THE 70th NAME-LIST OF VARIABLE STARS

The present 70th Name-List of Variable Stars compiled in the manner first introduced in the 67th Name-List (IBVS No. 2681,1985) contains all data necessary for identification of 165 new variables finally designated in 1990. The total number of designated variable stars has now reached 30264.

The 70th Name-List consists of two Tables. Table 1 contains the list of new variables arranged in the order of their right ascensions. It gives the ordinal number and the designation of each variable; its equatorial co-ordinates for the equinox 1950.0; the range of variability and the system of magnitudes used (sometimes the column "Min" gives in parentheses the amplitude of light variation; in the case of HZ Vir the amplitude is given in parentheses in the column "Max"); the type of variability according to the system of classification described in the forewords to the first three volumes of the 4th GCVS edition (with the additions introduced in the 68th Name-List, IBVS No. 3058, 1987, and in the 69th Name-List, IBVS No. 3323, 1989); two references to the reference list which follows the Table 2 (the first reference indicates the investigation of the star, the second one indicates the paper containing a finding chart or the corresponding Durchmusterung - BD, CoD, or CPD - containing the variable).

In a small number of cases the value of the variability amplitude (column "Min" or "Max", in parentheses) could not be expressed in the same system of magnitudes as the star's brightness; indicating the photometric band for the amplitude separately in such cases, we distinguish the Strömgren bands as "*u*","*v*", *etc.*

Table 2 contains the list of variables arranged in the order of their names inside constellations. After the designation of a variable its ordinal number from Table 1 is given, as well as all identifications needed for its finding in the papers with the first (or independent) announcement of the discovery of its variability. References to these papers are given in square brackets after the corresponding identification. The name of the discoverer in its original transcription accompanies the reference only in the case of its being different from the name of the author(s) of the paper referred to.

The 70th Name-List contains a number of variables in Taurus discovered by J. Kelemen [113]. Unfortunately the discovery announcement contains some mistakes in co-ordinates and in identifications with other lists. These mistakes have been corrected according to [114].

One correction to the 69th Name-List (IBVS No. 3323, 1989) has been found. Ref. 111 (p. 17) should be: *L. Rosino, M.Tsvetkov, K. Tsvetkova*, IBVS No. 2981, 1987.

E.V. KAZAROVETS, N.N. SAMUS
Astronomical Council of the
USSR Academy of Sciences

Table 1

No.	Name		$\alpha_{1950.0}$	$\delta_{1950.0}$	Max	Min		Type	Ref.	
001	AT	Scl	$00^h01^m38^s$	$-30^\circ24'.8$	7.08	(0.03)	V	ELL:	022	109
002	BC	Psc	00 02 47	−05 59.2	4.61	(0.08)	V	RS	157	BD
003	AU	Scl	00 12 36	−29 17.1	8.4	(0.01)	B	DSCTC	110	CoD
004	AV	Scl	00 20 43	−31 18.8	6.24	(0.03*u*)	U	ACV	022	CoD
005	PS	And	00 36 53	+37 55.5	10.7	11.4	P	SR	001	001
006	PT	And	00 37 42	+40 47.6	16.3	(19.5	B	UGSU	003	002
007	V369	Cep	00 41 12	+84 57.6	16.9	17.4	B	EW/KW	032	032
008	V370	Cep	00 42 12	+84 59.2	17.1	17.3	B	EW/KW	032	032
009	PU	And	00 42 40	+40 31.8	24.20	24.93	B	EB	004	
010	V371	Cep	00 43 13	+84 59.5	15.87	16.24	V	EB	032	032
011	V372	Cep	00 46 04	+85 01.8	14.0	14.1	B	FKCOM:	032	032
012	AW	Scl	01 04 06	−35 55.7	6.87	(0.04*u*)	U	ACV:	022	CoD
013	WZ	Tri	01 36 59	+28 56.7	18.4	18.8	B	E:	130	130
014	V666	Cas	01 57 58	+58 03.7	10.0	13.8	V	M	001	026
015	VV	For	02 50 22	−26 30.5	8.9	(0.02*v*)	V	DSCTC	056	CoD
016	WY	Ari	02 53 47	+19 53.6	12.42	12.61	V	INT	008	009
017	V667	Cas	03 15 57	+70 36.5	8.8	(14.5	P	M	028	027
018	V1002	Tau	03 38 15	+23 56.5	14.7	(18	U	UV	113	
019	V1003	Tau	03 39 49	+23 17.7	15.0	16.6	U	UV	115	116
020	V1004	Tau	03 40 00	+23 25.1	13.1	17.5	U	UV	113	117
021	V1005	Tau	03 42 08	+23 31.7	14.2	16.6	U	UV	113	117
022	V1006	Tau	03 42 12	+23 15.8	16	18	U	UV	113	117
023	V1007	Tau	03 42 28	+24 35.9	16	(18	U	UV	113	
024	V1008	Tau	03 42 33	+22 24.2	14.8	(18	U	UV	113	
025	V1009	Tau	03 42 43	+23 55.2	14.4	15.2	P	UV	118	117
026	V1010	Tau	03 42 52	+23 43.2	14.6	16.14	U	UV	113	117
027	V1011	Tau	03 43 17	+25 49.9	14.7	17.8	U	UV	113	
028	V1012	Tau	03 43 33	+22 04.2	15.7	18	U	UV	113	
029	V1013	Tau	03 44 46	+24 19.9	15.8	(18	U	UV	113	117
030	V1014	Tau	03 44 56	+22 30.1	16.6	(18	U	UV	113	
031	V500	Per	03 44 57	+50 41.5	9.8	10.7	P	SR	001	001
032	V1015	Tau	03 45 43	+24 28.2	15.3	(18	U	UV	113	117
033	V1016	Tau	03 45 44	+24 24.3	16.3	(18	U	UV	113	117
034	V1017	Tau	03 46 36	+23 51.6	14	(18	U	UV	113	117
035	V1018	Tau	03 47 45	+25 08.2	14.9	(18	U	UV	113	
036	V1019	Tau	03 48 44	+24 02.3	15.9	(18	U	UV	113	
037	V1020	Tau	03 48 51	+24 02.9	15.5	(18	U	UV	113	117
038	V1021	Tau	03 50 05	+22 31.0	15	(18	U	UV	113	
039	V1022	Tau	04 04 24	+27 43.6	14.45	15.25	B	EW/KW	119	119
040	V501	Per	04 12 03	+51 05.9	13.13	(0.13)	V	DSCT	090	090
041	V1023	Tau	04 15 41	+28 12.9	14.1	14.6	B	INT	122	121
042	V1024	Tau	04 16 29	+21 01.4	5.02	(0.03)	U	ACV	123	BD
043	V1025	Tau	04 32 54	+22 48.1	11.02	11.12	V	INSB	124	166
044	V1026	Tau	04 32 57	+22 48.5	17.2	(17.6	P	INT	126	125
045	V1027	Tau	04 43 29	+17 17.6	13.8	(15.5	V	M:	127	127
046	V1198	Ori	04 55 43	+00 22.7	7.12	7.19	V	RS	084	BD
047	EN	Eri	05 04 17	−04 43.2	4.89	(0.01*u*)	U	ACV:	022	BD
048	V1199	Ori	05 09 07	−08 38.0	8.8	(0.16)	V	DSCT:	085	085
049	V1028	Tau	05 24 17	+23 03.9	10.5	13.0	B	INT	128	129
050	V1200	Ori	05 34 05	−07 01.3	14.8	21.5:	B	UV	086	086
051	V1201	Ori	05 53 47	+05 22.2	13.0	14.12	V	*	088	087
052	OX	Gem	06 05 42	+25 39.3	8.1	9.1	P	L	057	057
053	BZ	Cam	06 23 47	+71 06.6	12.5	14.1	B	NL	011	010
054	V687	Mon	06 28 24	+10 28.2	12.27	13.29	V	INT	074	009

No.	Name		$\alpha_{1950.0}$	$\delta_{1950.0}$	Max	Min		Type	Ref.	
055	V688	Mon	$06^h34^m17^s$	+03°28'.1	9.19	11.2	H	M:	075	076
056	V689	Mon	06 36 03	+01 39.5	6.19	6.26	V	ACYG	077	BD
057	OY	Gem	06 55 41	+16 24	11.09	11.29	V	BE	058	058
058	V345	Pup	07 24 49	−47 37.2	18.16	20.00	B	EA/SD	093	093
059	BG	Lyn	07 53 03	+40 51.0	10.68	11.57	V	EB	070	071
060	BH	CMi	08 00 01	+01 51.6	9.3	(0.37:)	V	EW	020	BD
061	BI	CMi	08 02 56	+02 18.1	9.0	(0.1:)	V	DSCT:	021	BD
062	V346	Pup	08 08 51	−32 43.1	6.30	8.03	H	M:	075	076
063	BH	Lyn	08 18 53	+51 15.0	13.7	16.3	B	EA+NL:	072	073
064	EK	Cnc	08 29 06	+21 25	16.2	17.6	U	UV	013	
065	EL	Cnc	08 33 18	+20 12	17.9	21.0	P	UV	013	
066	EM	Cnc	08 35 29	+20 24.3	15	(17	U	UV	014	
067	EN	Cnc	08 36 00	+20 02.2	15.5	18	U	UV	014	
068	EO	Cnc	08 36 10	+20 13.2	14.0	16.9	U	UV	013	
069	EP	Cnc	08 38 04	+19 45.5	6.76	(0.03)	V	DSCTC	016	BD
070	EQ	Cnc	08 38 30	+20 02	15.8	17.1	P	UV	013	
071	LM	Vel	08 39 05	−44 52.8	7.54	7.57	V	ACYG	077	CoD
072	LN	Vel	08 40 15	−45 13.8	5.19	5.25	V	ACYG	077	CoD
073	LO	Vel	08 41 00	−46 59.7	18.32	(0.8)	V	E:	135	136
074	LP	Vel	08 41 02	−47 01.2	15.13	(0.35)	V	E:	135	136
075	LQ	Vel	08 41 04	−46 59.7	17.59	(0.08)	V	BY	135	136
076	ER	Cnc	08 42 57	+20 01.7	14.5	(17	U	UV	014	
077	LR	Vel	09 17 03	−51 20.9	5.82	5.96	V	ACYG	077	CoD
078	EN	UMa	10 17 17	+69 00.0	5.83	5.88	V	DSCTC	134	BD
079	V429	Car	10 39 23	−59 24.9	6.38	(0.12)	B	EA/WR	023	024
080	V430	Car	11 03 59	−59 40.8	6.68	(0.03)	V	BCEP:	025	CoD
081	DI	Cha	11 05 58	−77 21.8	10.65	10.74	V	INT	037	009
082	V431	Car	11 07 57	−60 42.5	8.09	(0.02)	B	E/WR	023	CoD
083	ξ	UMa	11 15 31	+31 48.6	4.38	(0.01)	V	RS	157	BD
084	V855	Cen	11 33 45	−61 25.5	9.58	(0.07)	B	BE	030	029
085	BN	CVn	12 27 11	+48 05.8	11.5	12	V	RR:	017	018
086	V856	Cen	12 54 44	−49 30.6	8.32	8.37	V	BCEP	031	CoD
087	HY	Vir	13 05 55	−02 24.8	7.81	8.10	V	EA	137	BD
088	IO	Com	13 18 39	+22 44.1	9.15	9.48	V	EA	038	038
089	BO	CVn	13 57 03	+41 03.7	9.48	10.10	V	EW	019	BD
090	HZ	Vir	13 57 16	−05 08.4	(1.73u)	11.98	V	UV	138	087
091	HL	Lib	14 27 50	−22 14.4	6.93	7.02	V	ELL:	065	BD
092	HS	Lup	15 04 35	−45 23.2	7.74	(0.04)	V	E:/RS:	067	CoD
093	HM	Lib	15 24 50	−24 59.8	7.42	7.63	V	SR:	066	CoD
094	HT	Lup	15 42 01	−34 08.1	10.26	10.40	V	INT	069	068
095	LU	TrA	15 56 46	−60 35.9	18.6	19.2	V	XI	131	132
096	V349	Nor	16 11 34	−52 47.8	8.70	8.77	V	BCEP	031	CoD
097	V972	Sco	16 20 19	−26 15.3	9.52	9.69	V	DSCT	103	171
098	V2245	Oph	16 22 47	−24 44.2	13.12	13.28	V	INT	153	078
099	V2246	Oph	16 23 02	−24 16.8	13.82	14.15	V	INT	153	079
100	V2247	Oph	16 24 18	−24 35.0	13.19	13.45	V	INT	080	081
101	V2248	Oph	16 29 09	−24 33.9	13.36	13.89	V	INT	153	079
102	LV	TrA	16 30 46	−67 01.4	8.28	8.35	V	RCB:	066	133
103	V973	Sco	16 48 04	−41 08.8	5.22	5.28	V	ACYG	077	CoD
104	V2249	Oph	16 50 02	−22 00.6	16.3	(0.6)	B	EW:	082	083
105	V2250	Oph	16 50 35	−22 09.3	15.7	(0.8)	B	EA	082	083
106	V829	Her	16 53 59	+35 15.6	10.1	(0.29R)	V	EW/KW	061	061
107	V974	Sco	17 00 45	−37 41.9	8.80	(0.07)	V	ACV	104	164
108	V975	Sco	17 19 14	−37 45.5	6.27	6.35	V	ACYG	077	CoD
109	V976	Sco	17 36 54	−32 10.5	11.51	11.68	V	DSCT	105	106
110	V4141	Sgr	17 47 25	−19 52.9	15.0	17.5	B	ZAND:	158	096

No.	Name		$\alpha_{1950.0}$	$\delta_{1950.0}$	Max	Min		Type	Ref.	
111	V977	Sco	$17^h48^m34^s$	$-32°31'.3$	10.0	(19	V	N	107	
112	V830	Her	17 50 44	+29 43.9	9.20	9.33	V	DSCT:	062	BD
113	V831	Her	18 02 36	+23 56.3	6.28	6.34	V	DSCTC:	063	BD
114	V4142	Sgr	18 04 35	−28 24.9	10.9	14.1	P	EA/DS	097	
115	EF	Dra	18 06 03	+69 44.8	10.48	(0.34)	V	EW/KW	055	055
116	V4143	Sgr	18 31 43	−33 16.5	16.4	17.3	B	RRC	098	098
117	V4144	Sgr	18 31 49	−33 19.3	16.3	17.1	B	RRC:	098	098
118	V4145	Sgr	18 32 03	−33 08.7	17.6:	18.8	B	RRAB	098	098
119	V4146	Sgr	18 33 04	−33 24.0	16.9	18.2:	B	RRAB	098	098
120	V4147	Sgr	18 33 07	−32 41.0	13.3	15.1	B	RRAB	098	098
121	V4148	Sgr	18 33 09	−32 42.4	15.7	16.6	B	RRAB	098	098
122	V4149	Sgr	18 33 18	−32 37.1	15.9	17.2	B	RRAB:	098	098
123	V4150	Sgr	18 33 24	−32 51.8	15.6	17.0	B	RRAB	098	098
124	V442	Sct	18 36 21	−07 54.3	9.42	9.45	V	ACYG	077	BD
125	V4151	Sgr	18 36 29	−25 39.8	15.2	(16	P	SRA:	101	101
126	V443	Sct	18 46 58	−06 14.7	8.5:	(13.2	V	NA	111	
127	V4152	Sgr	18 55 37	−29 34.4	9.24	9.52	V	SR:	066	CoD
128	EG	Dra	18 57 14	+54 05	14.8	16.5	P	M:	039	040
129	EH	Dra	19 03 43	+52 35	13.6	14.1	P	SRB:	039	040
130	V1943	Cyg	19 11 53	+49 47	12.1	13.2	P	LB	039	040
131	V1944	Cyg	19 12 52	+51 15	12.3	13.6	P	LB	039	040
132	V1945	Cyg	19 14 05	+54 13	15.2	16.3	P	SR	039	040
133	V4153	Sgr	19 17 18	−14 32.8	7.64	7.87	V	EA:	102	BD
134	V1946	Cyg	19 18 27	+49 17	14.5	15.3	P	LB	039	040
135	V1947	Cyg	19 19 58	+55 32	15.1	16.4	P	LB	039	040
136	V1948	Cyg	19 28 02	+50 03	13.8	15.6	P	L	039	040
137	V1949	Cyg	19 29 05	+50 42	12.8	13.8	P	RRAB	039	040
138	V1950	Cyg	19 36 25	+50 34	15.3	16.2	P	EA/SD	039	040
139	V1951	Cyg	19 36 55	+33 33	14.5	15.9	B	LB	041	041
140	V1952	Cyg	19 37 37	+48 07	14.6	15.7	P	LB:	039	040
141	V1953	Cyg	19 39 49	+50 43	14.8	15.6	P	SRB	039	040
142	V1954	Cyg	19 48 14	+55 26	15.4	16.0	P	LB:	039	040
143	QY	Sge	20 05 40	+18 34.2	12.37	12.57	V	SRD:	094	094
144	AV	Cap	20 05 47	−10 12.5	6.24	(0.02u)	B	ACV:	022	BD
145	V1955	Cyg	20 11 39	+48 25.8	13.6	14.3	B	SR:	042	042
146	LU	Del	20 39 40	+17 20.5	6.22	(0.25)	V	SR:	053	BD
147	V1956	Cyg	20 49 00	+43 46	16.2	17.5	P	UV	043	
148	V1957	Cyg	20 56 09	+43 41.0	16.0	18.0	U	UV	044	
149	V1958	Cyg	20 58 36	+43 04	14.5	16.6	U	UV	046	047
150	V1959	Cyg	21 02 56	+49 17.4	10.1	12.8	R	M:	048	048
151	V1960	Cyg	21 10 43	+37 20.5	15.3	17.8	B	EA/SD	049	049
152	V1961	Cyg	21 22 33	+39 45.2	14.9	15.6	B	EW:	050	050
153	CE	Gru	21 34 45	−43 55.8	17.4	19.5	V	AM	060	059
154	V1962	Cyg	21 37 08	+40 27.7	12.8	14.7	B	RRAB	051	051
155	V373	Cep	21 41 58	+65 53.1	11.82	12.89	V	INA	033	034
156	V1963	Cyg	21 42 14	+35 09.4	14.7	16.1	B	EA/SD	052	052
157	V375	Lac	22 32 28	+40 24.5	12.94	14.24	V	INA	064	034
158	BD	Psc	22 59 28	−02 27.8	]18	21	P	UV	092	092
159	KU	Peg	23 03 03	+25 44.4	7.7	(0.08)	V	RS	089	BD
160	V374	Cep	23 03 07	+61 59.6	10.2	10.7	V	BE	036	035
161	HQ	Aqr	23 21 37	−12 55.6	12.8	13.9	P	RR	006	
162	HR	Aqr	23 33 14	−11 16.2	13.3	15.2	B	RRAB	007	
163	BF	Phe	23 47 18	−42 34.7	7.7	(0.03b)	V	DSCTC	091	CoD
164	PV	And	23 53 06	+46 04.8	6.91	6.98	V	ACV	005	BD
165	BM	Cet	23 54 16	−11 12.2	15.9	17.0	B	RRC	007	

Table 2

PS	And=005=BD+37°112(9.3)= HD 3648(Mb)= =IRC+40012=DHK 2[001].
PT	And=006=R 15[003]= =Nova 15 in M 31[002].
PU	And=009=Var 33 [004].
PV	And=164=BD+45°4363(6.7)= =HD 224166(B9)[5,139].
HQ	Aqr=161=СПЗ 2859[006,*Горанский*].
HR	Aqr=162=СПЗ 2863[007,*Горанский*].
WY	Ari=016=LkHα 264[008]= =HRC 10=СПЗ 2871.
BZ	Cam=053=0623+71[012].
EK	Cnc=064=18[013]=B 17.
EL	Cnc=065=19[013]=B 18.
EM	Cnc=066=5[014].
EN	Cnc=067=6[014].
EO	Cnc=068=20[013]=KW 561 [015]=B 19.
EP	Cnc=069=BD+20°2175(7.7)= =HD 73819(A3)[016]= =KW 348[015].
EQ	Cnc=070=17[013]=B 16.
ER	Cnc=076=7[014].
BN	CVn=085=D[018].
BO	CVn=089=BD+41°2447(8.7) [019].
BH	CMi=060=BD+2°1855(9.3) [140]=325.1934=P 3098= =КЗП 1202=NSV 03867.
BI	CMi=061=BD+2°1867(9.0) [021]=HD 66853(F2).
AV	Cap=144=BD-10°5285(6.0)= =HD 191110(A0)[022]= =HR 7694.
V429	Car=079=CoD-59°3221(7.2)= =CPD-59°2450(6.8)= =HD 92740(Oop)= =HR 4188=КЗП 101151= =NSV 04939=WR 22= =He3-470=LSS 1761= =220G.Car[142].
V430	Car=080=CoD-59°3544(7.2)= =CPD-59°3038(7.2)= =HD 96446(B3p)[025].
V431	Car=082=CoD-60°3396(8.8)= =CPD-60°2578(8.0)= =HD 97152(Oa)[023]= =WR 42=He3-603= =LSS 2198.
V666	Cas=014=LD 103[026]= =DHK 1[001]= =TAV 0157+58.
V667	Cas=017=BD+70°236(9.4) [141]=P 2562= =976.1935=КЗП 284= =NSV 01098.
V855	Cen=084=CPD-61°2432(9.1)= =HD 306797(B)= =Ahmed 240(NGC 3766) [030]=He3-681.
V856	Cen=086=CoD-49°7513(8.3)= =CPD-49°5591(8.2)= =HD 112481(B2)[031].
V369	Cep=007=V7(NGC 188)[032].
V370	Cep=008=V6(NGC 188)[032].
V371	Cep=010=V5(NGC 188)[032]= =I-11(NGC 188)[143].
V372	Cep=011=V8(NGC 188)[032].
V373	Cep=155=HRC 309=LkHα 234 [144]=NSV 13859.
V374	Cep=160=BHJ 71[036]= =СПЗ 2870.
BM	Cet=165=СПЗ 2864[007,*Горанский*].
DI	Cha=081=CoD-76°486(10.1) [037]=CPD-76°652(9.9)= =He3-593=HM 13=HRC 245 [009]=LHα 332-17= =NSV 05099.
IO	Com=088=BD+23°2562(8.5)= =HD 116093(G5)[038].
V1943	Cyg=130=S 9669[040]= =NSV 11837.
V1944	Cyg=131=S 9670[040]= =NSV 11848.
V1945	Cyg=132=S 9671[040]= =NSV 11867.
V1946	Cyg=134=S 9672[040]= =NSV 11927.
V1947	Cyg=135=S 9673[040]= =NSV 11951.
V1948	Cyg=136=S 9674[040]= =NSV 12092.
V1949	Cyg=137=S 9676[040]= =NSV 12111.
V1950	Cyg=138=S 9678[040]= =NSV 12246.
V1951	Cyg=139=СПЗ 2866= =var[041].
V1952	Cyg=140=S 9679[040]= =NSV 12271.
V1953	Cyg=141=S 9680[040]= =NSV 12315.
V1954	Cyg=142=S 9681[040]= =NSV 12463.

V1955 Cyg=145=CCS 2881[042]=
=СПЗ 2867.
V1956 Cyg=147=Cyg Fl No.42=B 59
[043,*Tsvetkov,Erastova*].
V1957 Cyg=148=B 12[045].
V1958 Cyg=149=B 45[046].
V1959 Cyg=150=CSS 1259[048]=
=СПЗ 2869.
V1960 Cyg=151=СПЗ 2831[049,*Шугаров*].
V1961 Cyg=152=СПЗ 2862[050,*Шугаров*].
V1962 Cyg=154=СПЗ 2861[051,*Шугаров*].
V1963 Cyg=156=СПЗ 2860[052,
Д.Ляпунов].
LU Del=146=BD+17°4382(6.5)=
=HD 197249(K0)=HR 7923
[053].
EF Dra=115=1E 1806.1+6944
[055].
EG Dra=128=S 9665[040]=
=NSV 11626.
EH Dra=129=S 9666[040]=
=NSV 11735.
EN Eri=047=BD-4°1044(5.0)=
=HD 32964(B9)=66 Eri
[054]=HR 1657[022]=
=ADS 3698A=КЗП 6147=
=NSV 01831.
VV For=015=CoD-26°1051(9.1)=
=CPD-26°272(8.8)=
=HD 17978(A2)[056].
OX Gem=052=BD+25°1131(7.6)=
=HD 41890(Ma)=
=IRC+30138=Wr 59[145]=
=КЗП 6425=NSV 02839.
OY Gem=057=HD 51585(Peo)[146,
058]=MWC 162.
CE Gru=153=V1[059].
V829 Her=106=1E 1654+3515[061].
V830 Her=112=BD+29°3132(8.8)
[062].
V831 Her=113=BD+23°3254(7.1)=
=HD 165373(F0)=HR 6754
[063].
V375 Lac=157=HRC 313[009]=
=LkHα 233=Марк 914=
=NSV 14227.
HL Lib=091=BD-21°3917(7.0)=
=CPD-21°5730(7.2)=
=HD 127208(B8)[147].
HM Lib=093=CoD-24°12084(7.6)=
=CPD-24°5512(7.9)=
=HD 137613(R0)[148]=
=CCS 2250=Hen 225=
=NSV 07085.
HS Lup=092=CoD-45°9664(7.4)=
=CPD-45°7211(7.6)=
=HD 133822(G5)[149,
Stoy]=КЗП 102762=
=NSV 06941.
HT Lup=094=CoD-33°10685(9.5)=
=HRC 248[009]=
=He3-1095=NSV 07226.
BG Lyn=059=RR VI-51[071].
BH Lyn=063=PG 0818+513[150]=
=СПЗ 2865.
V687 Mon=054=HRC 203[009]=
=LkHα 274=NSV 02996.
V688 Mon=055=AFGL 971=CRL 971
[151].
V689 Mon=056=BD+1°1443(6.8)=
=HD 47432(B0)=HR 2442
[152]=КЗП 6469=
=NSV 03060.
V349 Nor=096=CoD-52°7312(8.6)=
=CPD-52°9416(8.4)=
=HD 145794(B2)[031].
V2245 Oph=098=HBC 636=ROX 3
[078,153].
V2246 Oph=099=HBC 637=ROX 8
[153]=Do-Ar 21
[079]=Haro 1-6.
V2247 Oph=100=HRC 263[009]=
=ROX 21=SR 12=
=NSV 07725.
V2248 Oph=101=HBC 647=ROX 47=
=Do-Ar 51[079,154].
V2249 Oph=104=V3(NGC 6235)[083].
V2250 Oph=105=V4(NGC 6235)[083].
V1198 Ori=046=BD+0°908(7.8)=
=HD 31738(G5)[084].
V1199 Ori=048=C2[085].
V1200 Ori=050=3[086].
V1201 Ori=051=WD 0553+053=
=Gliese 1087=
=G99-47[155; 088,
Middleditch]=Gr 290=
=LHS 212=LTT 17891.
KU Peg=159=BD+25°4870(7.7)=
=HD 218153(K0)[089].
V500 Per=031=BD+50°829(9.0)=
=HD 232842(M4)=
=IRC+50106=DHK 5[001].
V501 Per=040=S1-F[090].
BF Phe=163=CoD-42°16486(7.7)=
=CPD-42°9618(7.3)=
=HD 223480(F0)[091].
BC Psc=002=BD-6°6357(5.2)=
=HD 28(K0)[156]=

=33 Psc=HR 3=IRC-10002.
BD Psc=158=flare star [092].
V345 Pup=058=1(Melotte 66) [093].
V346 Pup=062=AFGL 1235[075].
QY Sge=143=IRAS 20056+1834 [094].
V4141 Sgr=110=Th 4-4[095]= =PK8+3°2=CПЗ 2872.
V4142 Sgr=114=eclipsing binary [097].
V4143 Sgr=116=F5[098].
V4144 Sgr=117=F15[098].
V4145 Sgr=118=F10[098].
V4146 Sgr=119=F4[098].
V4147 Sgr=120=F8[098]=32[099]= =Zi 1439=KЗП 4222= =NSV 11073.
V4148 Sgr=121=F12[098].
V4149 Sgr=122=F6[098].
V4150 Sgr=123=F2[098].
V4151 Sgr=125=HV 9493=P 4803= =926.1936[100]= =KЗП 4268=NSV 11157.
V4152 Sgr=127=CoD-29°15574(8.9)= =CPD-29°5823(9.2)= =HD 175893(R1)[066].
V4153 Sgr=133=BD-14°5392(7.3)= =HD 181219(K0)[102].
V972 Sco=097=CoD-26°11310(9.2)= =CPD-26°5630(8.8)= =HD 147491(G0)= =Lee 2202(M 4)[163].
V973 Sco=103=CoD-41°10957(5.9)= =CPD-41°7667(6.3)= =HD 151804(0e)[159]= =HR 6245=NSV 07992.
V974 Sco=107=CoD-37°11215(8.5)= =CPD-37°6884(8.4)= =HD 153947(B8)[104]= =NGC 6281-9.
V975 Sco=108=CoD-37°11507(6.9)= =CPD-37°7121(7.1)= =HD 157038(B8p)[077]= =HR 6450.
V976 Sco=109=31(NGC 6405)[105].
V977 Sco=111=Nova Sco 1989 [107].
AT Scl=001=CoD-30°19809(6.9)= =CPD-30°6843(6.8)= =HD 225187(B8)[022]= =8(Blanco 1)[108]= =71(ζ Scl)=NSV 00009.
AU Scl=003=CoD-29°50(8.6)= =CPD-29°19(8.4)= =HD 1097(A3)[110].
AV Scl=004=CoD-31°138(6.6)= =CPD-31°43(6.4)= =HD 1909(B9)[022]= =HR 89.
AW Scl=012=CoD-36°417(6.5)= =CPD-36°118(6.9)= =HD 6619(B9)[022]= =HR 323.
V442 Sct=124=BD-7°4642(9.0)= =HD 172175(B0)[077].
V443 Sct=126=Nova Sct 1989 [160].
V1002 Tau=018=63[113].
V1003 Tau=019=2[115]=TCSN 87 [116].
V1004 Tau=020=44[113]=HII 29.
V1005 Tau=021=53[113]=HII 539.
V1006 Tau=022=56[113]=HII 564.
V1007 Tau=023=58[113].
V1008 Tau=024=7[113].
V1009 Tau=025=Plf 526[118]= =HII 749.
V1010 Tau=026=3[113]=HII 799 [161]=NSV 01281.
V1011 Tau=027=13[113].
V1012 Tau=028=51[113].
V1013 Tau=029=64[113]=HII 1551.
V1014 Tau=030=25[113].
V1015 Tau=032=60[113]=HII 1963.
V1016 Tau=033=50[113]=HII 1971.
V1017 Tau=034=90,91[113]= =HII 2337.
V1018 Tau=035=2[113].
V1019 Tau=036=9[113].
V1020 Tau=037=94[113]=HII 3146.
V1021 Tau=038=35[113].
V1022 Tau=039=HV 6199[162]= =P 2604=KЗП 380= =NSV 01464.
V1023 Tau=041=2[120]=Hubble 4 [121,*Stone*]=HBC 374= =IRAS 04157+2813= =Hubble's star.
V1024 Tau=042=BD+20°733(6.2)= =HD 27295(B8)=53 Tau= =HR 1339[165].
V1025 Tau=043=28[120]=HP Tau/G2 [124]=HBC 415.
V1026 Tau=044=Haro 6-28= =HBC416=CПЗ 1325[126]= =KЗП 6115=NSV 01656.
V1027 Tau=045=new variable[127].
V1028 Tau=049=BD+22°909(9.3)= =HD 243750(M7)=

=IRC+20106=DHK 3[129].

WZ Tri=013=S 10922[130].

LU TrA=095=4U 1556-605[131]=
43(1556-605).

LV TrA=102=CoD-66°1961(8.5)=
=CPD-66°2978(8.7)=
=HD 148839(R0)[066]=
=CCS 2342=NSV 07820.

EN UMa=078=BD+69°568(6.0)=
=HD 89343(F0)=HR 4047
[134].

ξ UMa=083=BD+32°2132(3.7)=
=HD 98230/1(G0)=53 UMa=
=ADS 8119=HR 4374/5=
=36[112]=NSV 05165
(B component probably variable).

LM Vel=071=CoD-44°4683(8.1)=
=CPD-44°2911(8.0)=
=HD 74194(B2)[167].

LN Vel=072=CoD-44°4704(5.9)=
=CPD-44°2936(6.0)=
=HD 74371(B5)=HR 3456
[168,077].

LO Vel=073=168(NGC 2660)
[135]=2204(NGC 2660).

LP Vel=074=459(NGC 2660)
[135]=4125(NGC 2660).

LQ Vel=075=160(NGC 2660)
[135]=1241(NGC 2660).

LR Vel=077=CoD-51°3693(6.3)=
=CPD-51°2101(7.4)=
=HD 80558(B8p)=
=HR 3708=8908[169]=
=NSV 04454.

HY Vir=087=BD-1°2777(8.5)
[170]=HD 114125(F2).

HZ Vir=090=G 64-34[138]=
=LTT 5465=L 979-81.

REFERENCES

001. *D.H.Kaiser, D.B.Williams, M.E.Baldwin*, IBVS No.3313,1989.
002. *C.Grubissich, L.Rosino*, Asiago Contr No.93,1959.
003. *А.С.Шаров, А.К.Алкснис*, ПАЖ 15, № 10,885,1989.
004. *T.J.Davidge, C.J.Pritchet*, PASP **100**, No.628,730,1988.
005. *C.R.Stagg, H.Božić, A.W.Fullerton, W.S.Gao, Z.H.Guo, P.Harmanec, J.Horn, L.Huang, L.H.Iliev, P.Koubský, B.Z.Kovachev, K.Pavlovski, J.R.Percy, P.Schmidt, S.Štefl, N.A.Tomov, J.Žižňovský*, MN **234**, No.4,1021,1988.
006. *А.С.Боричук*, MS,1988.
007. *А.В.Чичеров*, MS,1990.
008. *O.Paupers, U.Dzervitis, V.Straižys, K.Černis*, Вильнюс бюлл № 84,21,1989.
009. *G.H.Herbig, N.K.Rao*, Lick Contr No.355,1971=ApJ **174**,401, 1972.
010. *G.Williams*, ApJ Suppl **53**,No.3,523,1983.
011. *P.Garnavich, P.Szkody*, PASP **100**,No.634,1522,1988.
012. *G.L.Ellis, E.T.Grayson, H.E.Bond*, PASP **96**,283,1984.
013. *I.Jankovics*, Bamberg Veröff **11**, No.121,120,1977.
014. *G.Oganijan, I.Jankovics, J.Kelemen*, IBVS No.2149,1982.
015. *W.J.Klein Wassink*, Publ Kapteyn Astr Lab No.41,1927.
016. *B.E.Martin, D.P.Hube*, IBVS No.3324,1989.
017. *T.Brelstaff*, TA **23**, No.269,75,1986.
018. *T.Brelstaff*, TA **23**, No.268,58,1986.
019. *T.Oja*, IBVS No.3288,1989.
020. *B.Zakrzewski, S.Zola*, IBVS No.3360,1989.
021. *M.Kurpinska-Winiarska, M.Winiarski, St.Zola*, IBVS No.3275, 1988.
022. *H.Schneider*, Hvar Obs Bull **11**, No.1,29,1987.
023. *L.A.Balona, J.Egan, F.Marang*, MN **240**,103,1989.
024. *L.O.Lodén, K.Lodén, B.Nordström, A.Sundman*, AsAp Suppl **23**, No.3,283,1976.

025. *J.M.Matthews, D.A.Bohlender,* IBVS No.3326,1988.
026. *L.Dahlmark,* IBVS No.2878,1986.
027. *G.M.Hurst,* TA **25**,No.298,203,1989.
028. *D.Böhme,* The poster paper presented at the First European Meeting of the AAVSO (Brussels), 1990.
029. *F.Ahmed,* Edinburgh Publ **3**, No.3,57,1962.
030. *G.M.van Vuuren, L.A.Balona, F.Marang,* MN **234**,No.2,373,1988.
031. *C.Waelkens, D.Heynderickx,* AsAp **208**,129,1989.
032. *J.Kaluzny, M.M.Shara,* ApJ **314**,585,1987.
033. *В.С.Шевченко, С.Д.Якубов,* АЖ **66**, вып.4,718,1989.
034. *G.H.Herbig,* ApJ Suppl **4**,337,1960.
035. *A.Blaauw, W.A.Hiltner, H.L.Johnson,* ApJ **130**,No.1,69,1959.
036. *N.D.Melikian, V.S.Shevchenko, M.A.Ibragimov, S.D.Jakubov, A.V.Chernyshev,* IBVS No.3187,1988.
037. *D.Kilkenny, D.C.B.Whittet, J.K.Davies, A.Evans, M.F.Bode, E.I.Robson, R.M.Banfield,* SAAO Circ No.9,55,1985.
038. *O.Ohshima, Y.Ito,* IBVS No.3332,1989.
039. *H.Gessner,* MVS **11**,H.7,150,1988.
040. *C.Hoffmeister,* AN **289**,H.5,205,1967.
041. *А.П.Кацыка,* АЦ № 1526,14,1988.
042. *А.Алкснис, З.Алксне,* "Углеродные звезды в области Лебедя", Рига, "Зинатне", 1988,стр.34.
043. *M.K.Tsvetkov, K.P.Tsvetkova,* A Catalogue of Flare Stars in the Cygnus Region,1989 (Preprint,Astronomisches Institut der Universität Münster).
044. *H.S.Chavushian, I.Jankovics,* IBVS No.2814,1985.
045. *M.K.Tsvetkov, H.S.Chavushian, K.P.Tsvetkova,* IBVS No.938, 1974.
046. *N.D.Melikian, H.S.Chavushian, M.K.Tsvetkov,* IBVS No.1470, 1978.
047. *Н.Д.Меликян, Г.А.Брутян,* Бюракан сообщ № 57,70,1985.
048. *З.Алксне, А.Алкснис, З.Дзиие,* Исследование Солнца и красных звезд, вып.29, 5, 1988.
049. *Н.И.Бондарь, С.Ю.Шугаров,* ПЗ **23** (в печати).
050. *Ю.В.Кулагин, С.Ю.Шугаров,* АЦ № 1541,11,1990.
051. *Д.В.Безяев, С.Ю.Шугаров,* АЦ № 1534,20,1988.
052. *А.Л.Качалов, С.Ю.Шугаров,* АЦ № 1534,19,1988.
053. *D.Böhme,* IBVS No.3186,1988.
054. *F.B.Wood,* Princ Contr No.25,60-62,1951.
055. *R.M.Robb, C.D.Scarfe,* IBVS No.3370,1989.
056. *C.Sterken, M.Jerzykiewicz,* IBVS No.3321,1989.
057. *T.Berthold,* Hartha Mitt H.22,6,1989.
058. *В.П.Архипова,* ПАЖ **15**, № 10, 925,1989.
059. *M.R.S.Hawkins,* Nature **293**,No.5828,116,1981.
060. *I.R.Tuohy, L.Ferrario, D.T.Wickramasinghe, M.R.S.Hawkins,* ApJ **328**, L59, 1988.
061. *R.M.Robb,* IBVS No.3346,1989.
062. *R.V.Jones, B.W.Carney, D.W.Latham,* ApJ **332**,206,1988.
063. *J.D.Fernie,* IBVS No.3378,1989.
064. *А.В.Чернышев, В.С.Шевченко,* АФ **29**,вып.1,58,1988.
065. *R.C.Dempsey, B.W.Bopp, S.B.Parsons, F.C.Fekel,* BAAS **21**,No.2, 746,1989.
066. *D.Kilkenny, F.Marang, J.W.Menzies,* MN **233**,209,1988.
067. *B.E.Helt, K.S.Jewsen,* IBVS No.3306,1989.
068. *Pic-Sin The,* Bosscha Contr No.15,1962.
069. *В.И.Кардополов, Г.К.Филиппьев, А.Ф.Майлиева, Н.А.Шутелова,* ПЗ **22**,№ 4,461,1987.
070. *R.Dequinze,* GEOS EB 16,1988.
071. *T.D.Kinman, C.T.Mahaffey, C.A.Wirtanen,* AJ **87**,No.2,314,1982.
072. *I.L.Andronov, G.N.Kimeridze, G.A.Richter, V.P.Smykov,* IBVS

No.3388,1989.
073. *R.F.Green, D.H.Ferguson, J.Liebert, M.Schmidt*, PASP **94**, No. 559,560,1982.
074. *В.С.Шевченко, С.Д.Якубов*, АЖ **65**,вып.5,927,1988.
075. *T.LeBerte*, AsAp **203**,85,1988.
076. *D.A.Allen, A.R.Hyland, A.J.Longmore, J.L.Caswell, W.M.Goss, R.F.Haynes*, ApJ **217**,No.1,108,1977.
077. *A.M.van Genderen, H.Bovenschen, E.C.Engelsman, P.Goudfrooy, M.P.van Haarlem, D.Hartmann, H.J.Latour, Y.K.Ng, J.J.Prein, F.H.P.M.van Roermund, H.J.A.Röttgering, F.W.M.Steeman, W.Tijdhof*, AsAp Suppl **79**,No.2,263,1989.
078. *Th.Montmerle, L.Koch-Miramond, E.Falgarone, J.E.Grindlay*, ApJ **269**,182,1983.
079. *М.В.Долидзе, М.А.Аракелян*, АЖ **36**,вып.3,444,1959.
080. *J.Bouvier, C.Bertout*, AsAp **211**,99,1989.
081. *O.Struve, M.Rudkjøbing*, ApJ **109**,92,1949.
082. *M.H.Liller*, AJ **85**,673,1980.
083. *M.H.Liller*, AJ **82**,No.9,711,1977.
084. *T.Lloyd Evans, M.C.J.Koen*, SAAO Circ No.11,21,1987.
085. *R.Peniche, J.H.Pena*, IBVS No.3221,1988.
086. *R.K.Konstantinova-Antova, M.K.Tsvetkov*, IBVS No.3190,1988.
087. *H.L.Giclas, R.Burnham,Jr., N.G.Thomas*, Lowell Bull **5**, No.7, 61,1961.
088. *B.E.Schaefer*, ApJ **337**,No.2,927,1989.
089. *K.G.Strassmeier, D.S.Hall*, ApJ Suppl **67**,453,1988.
090. *O.Bruegman*, Observatory **109**,No.1090,95,1989.
091. *E.Rodriguez, A.Rolland, P.Lopez de Coca*,IBVS No.3336,1989.
092. *R.H.McNaught*, IBVS No.3395,1989.
093. *J.Kaluzny, M.M.Shara*, AJ **95**,No.3,785,1988.
094. *J.W.Menzies, P.A.Whitelock*, MN **233**,697,1988.
095. *Л.Н.Кондратьева*, ПАЖ **15**,№ 1,29,1989.
096. *L.Perek, L.Kohoutek*, Catalogue of Galactic Planetary Nebulae, Prague, 1967.
097. *M.J.Keyes*, IBVS No.507,1971.
098. *M.L.Hazen*, AJ **97**,No.3,771,1989.
099. *R.I[nnes]*, UOC No.20,1914.
100. *W.J.Luyten*, AN **261**,456,1937.
101. *D.Hoffleit*, JAAVSO **7**,No.2,81,1978/79.
102. *L.R.Patterson, D.S.Hall*, IBVS No.3319,1989.
103. *Yao Bao-An, Tong Jian-Hua*, IBVS No.3334,1989.
104. *P.North, G.Jasniewicz, Ch.Waelkens*, IBVS No.3199,1988.
105. *H.Schneider*, IBVS No.2626,1984.
106. *K.Rohlfs, K.-W.Schrick, J.Stock*, ZsAp **47**,15,1959.
107. *W.Liller*, IAU Circ No.4836,1989.
108. *I.Epstein*, AJ **73**,556,1968.
109. *B.E.Westerlund, R.Garnier, K.Lundgren, B.Pettersson, J.Breysacher*, AsAp Suppl **76**,101,1988.
110. *D.W.Kurtz*, MN **238**,1077,1989.
111. IAU Circ No.4862,1989.
112. *G.Jackisch*, VSS **5**,H.5,1963.
113. *J.Kelemen*, IBVS No.3103,1987.
114. *J.Kelemen*, MS,1989.
115. *N.D.Melikian, I.Jankovics, J.Kelemen*, IBVS No.2019,1981.
116. *G.Haro, E.Chavira, G.Gonzáles*, Ton Bol **3**,No.1,3,1982.
117. *E.Hertzsprung*, Leiden Ann **19**,part 1A,1947.
118. *Л.В.Мирзоян, О.С.Чавушян, Г.Б.Оганян, В.В.Амбарян, А.Т.Гарибджанян, Н.Д.Меликян, Р.Ш.Нацвлишвили*, АФ **17**,№ 1,71,1981.
119. *J.Pensado, J.F.Lahulla*, PASP **101**,No.636,177,1989.
120. *Г.С.Бадалян*, ДАН Арм.ССР **31**,261,1960.
121. *G.H.Herbig*, ApJ **214**,747,1977.

122. *У.А.Нурманова*, ПЗ **21**,№ 6,777,1983.
123. *F.A.Catalano, F.Leone, S.Vaccari*, IBVS No.3220,1988.
124. *F.J.Vrba, A.E.Rydgren, P.F.Chugainov, N.I.Shakovskaya, W.Bruce Weaver*, AJ **97**,No.2,483,1989.
125. *G.Haro, B.Iriarte, E.Chavira*, TTB No.8,1953.
126. *Г.С.Бадалян*, АЦ № 224,1961.
127. *M.Huruhata*, Var Star Bull (Japan) No.5,20,1988.
128. *D.B.Williams*, IBVS No.3314,1989.
129. *D.H.Kaiser*, JAAVSO **16**,No.2,130,1987.
130. *G.A.Richter*, MVS **11**,H.8,206,1989.
131. *C.Motch, M.W.Pakull, M.Mouchet, K.Beuermann*, AsAp **219**, No. 1/2,158,1989.
132. *C.A.Reid, M.D.Johnston, H.V.Bradt, R.E.Doxsey, R.E.Griffiths, D.A.Schwartz*, AJ **85**,No.8,1062,1980.
133. *F.M.Bateson, M.Morel*, Charts for Southern Variables,Ser. No. 18,1985.
134. *R.Plume, J.R.Percy*, IBVS No.3225,1988.
135. *S.Frandsen, P.Dreyer, H.Kjeldsen*, AsAp **215**,287,1989.
136. *F.D.A.Hartwick, J.E.Hesser*, ApJ **183**,No.3,883,1973.
137. *R.Casas, J.M.Gomez-Forrellad*, IBVS No.3337,1989.
138. *W.J.Schuster*, IBVS No.3256,1988.
139. *Huang Lin*, Beijin Publ No.6,24,1984.
140. *C.Hoffmeister*, AN **253**,197,1934.
141. *O.Morgenroth*, AN **258**,265,1936.
142. *B.A.Gould*, Cord Res **1**,1879.
143. *O.J.Eggen, A.Sandage*, ApJ **158**,669,1969.
144. *A.F.Aveni, J.H.Hunter*, AJ **77**,17,1972.
145. *R.Weber*, JO **41**,74,1958.
146. *Y.Andrillat, L.Houziaux*, ApSS **15**,236,1972.
147. *E.H.Olsen*, AsAp Suppl **29**,313,1977.
148. *P.M.Corben, B.S.Carter, R.M.Banfield, G.M.Harvey*, MNASSA **31**, Nos.1-2,7,1972.
149. *D.Evans*, Observatory **80**,134,1960.
150. *И.Л.Андронов*, АЦ № 1418,1,1986.
151. *K.M.Merrill, W.A.Stein*, PASP **88**,874,1976.
152. *A.W.Cousins*, MNASSA 22,No.4,58,1963.
153. *J.Bouvier, C.Bertout, P.Bouchet*, AsAp Suppl **75**,1,1988.
154. *A.E.Rydgren, S.E.Strom, K.M.Strom*, ApJ Suppl **30**,307,1976.
155. *A.G.Agayev, O.H.Guseinov, H.I.Novruzova*, ApSS **81**,5,1982.
156. *O.J.Eggen*, IBVS No.1426,1978.
157. *K.G.Strassmeier, D.S.Hall, L.J.Boyd, R.M.Genet*, ApJ Suppl **69**, 141,1989.
158. *Н.Е.Курочкин*, MS,1990.
159. *B.J.Bok, P.F.Bok, J.A.Graham*, MN **131**,247,1966.
160. *P.Wild*, IAU Circ No.4861,1989.
161. *B.Iriarte*, TTB **4**,No.28,79,1967.
162. *H.Shapley, E.Hughes*, HA **90**, No.4,1934.
163. *G.Clementini*, PASP **99**,No.617,637,1987.
164. *A.Feinstein, J.C.Forte*, PASP **86**,No.511,284,1974.
165. *J.E.Winzer*, Dissertation, 1971.
166. *M.Cohen, L.V.Kuhi*, ApJ Suppl **41**, No.4,743,1979.
167. *A.M.van Genderen, A.K.van den Boogaart, J.Brand, J.W.de Bruyn, J.H.Burger, M.D.P.van der Bij, E.R.Deul, G.M.van Heerde, J.R.A.Hootmeyer, H.Kraakman, L.de Lange, G.Lemstra, J.Oppe, M.J.J.Wiertz*, AsAp Suppl **62**,No.2,291,1985.
168. *F.Rufener, P.Bartholdi*, AsAp Suppl **48**, No.3,503,1982.
169. *M.P.FitzGerald*, AsAp Suppl **9**,No.3,297,1973.
170. *E.Rodriguez, J.L.Sedano, P.Lopez de Coca, A.Rolland*, IBVS No. 3174,1988.
171. *S.-W.Lee*, AsAp Suppl **27**,367,1977.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3531

Konkoly Observatory
Budapest
24 October 1990

HU ISSN 0374 - 0676

A NEW, APPARENTLY UNUSUAL DELTA SCUTI STAR, HD 18878

Small brightness variability of HD 18878 (FO) = BD+47°760 = SAO 38543 was first discovered by one of us (A.V.K.) during a short series of photoelectric observations (JD 2447501, 2447502). The observations were carried out at High Altitude Tian-Shan station (near Alma-Ata) of the Sternberg As-

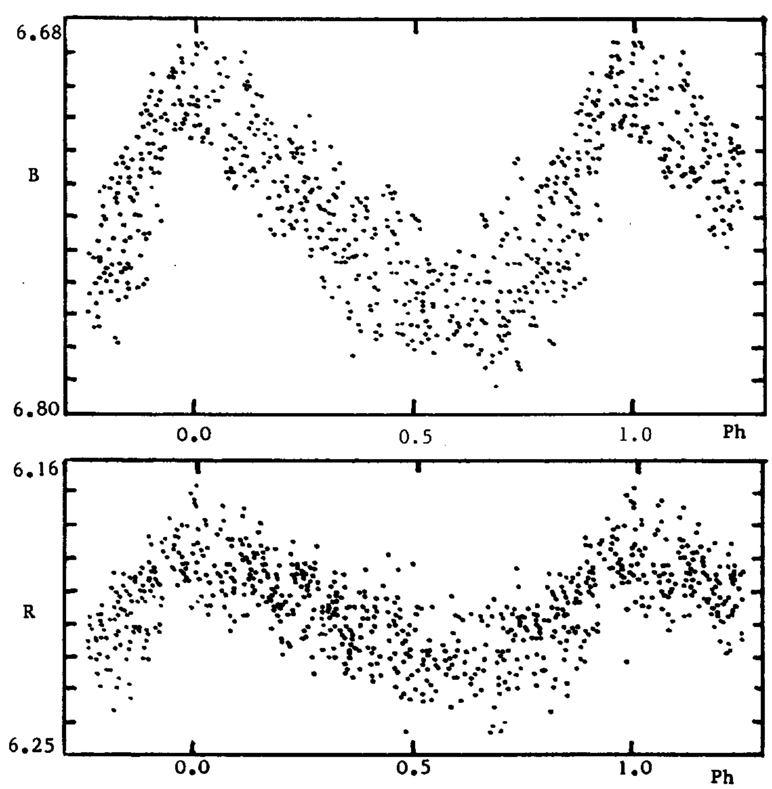


Figure 1

Fig. 1 B and V light curves of HD 18878. All 610 observations are plotted with P=0^{d}.145785. The star keeps its period during more than 2600 pulsation cycles: from JD 2447501 to JD 2447883.

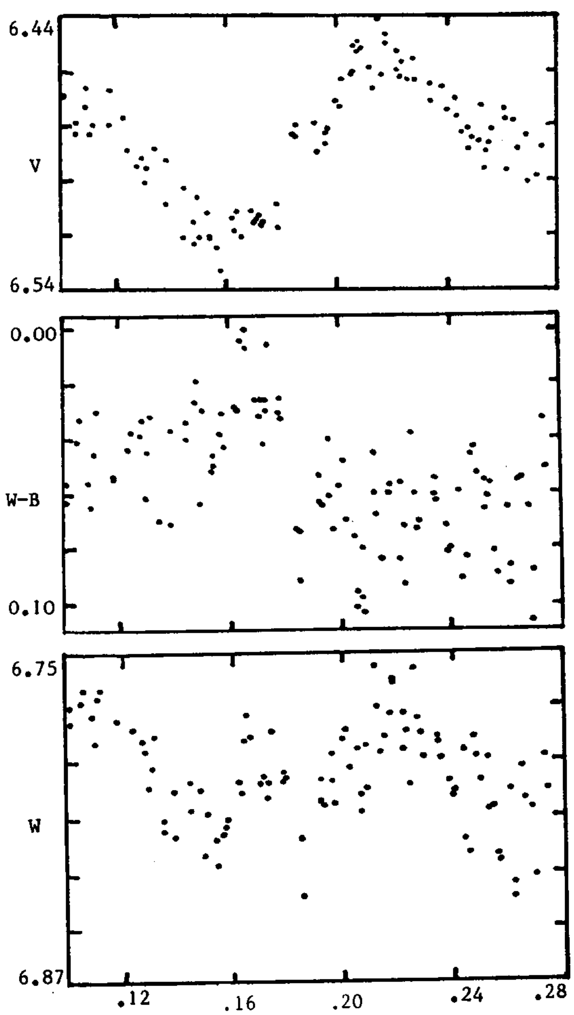


Figure 2

Fig. 2 V and W light curves and W-B colour curve of HD 18878 on JD 2447882. Sudden peaks in W and in W-B are seen near the time of light minimum of the V light curve.

tronomical Institute using a photoelectric photometer attached to the 19" reflector. The comparison star was HD 18411. Differential observations were transformed to the WBVR system (see Khaliullin et al., 1985), where W is similar (but not identical) to the standard U band.

During four nights JD 2447858, 2447873, 2447882 and 2447883 additional series of WBVR observations of the new variable star were carried out with

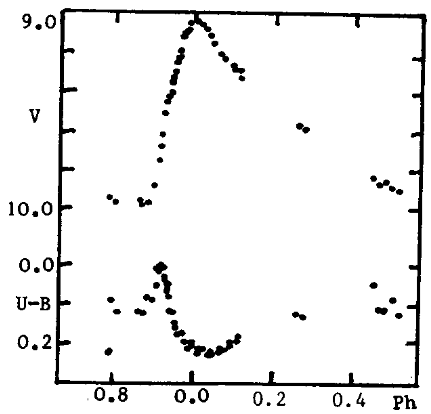


Figure 3

Fig. 3 V light curve and U-B colour curve of the RRab-type star X Ari (P= $0^{d}.651$, strong metal deficiency) from Preston (1961). Compare the behaviour of the U-B curve with the W-B curve of the new variable HD 18878 in Fig. 2.

Table I

Mean magnitudes of comparison star and standard stars

Star	W	B	V	R
HD 18411 (comp.)	4.864	4.737	4.694	4.604
HD 11335	6.407	6.310	6.288	6.225
HD 10307	5.482	5.559	4.966	4.435

the same equipment and with the same comparison star. Two standard stars HD 11335 and HD 10307 were also observed (Table I). The extreme limits of brightness and colour variations of HD 18878 are: 6.720-6.879 W, 6.687-6.798 B, 6.641-6.533 V, 6.168-6.249 R, 0.000-0.118 W-B, 0.227-0.275 B-V, 0.246-0.312 V-R.

HD 18878 shows periodic light and colour variations, more scattered in W and especially in W-B. Light and colour amplitudes differ from one cycle to another. Such a manner of variability at the spectral type F0 is typical for Delta Scuti stars. The analysis of all our 610 observations has revealed the presence of regular pulsations of the star with the following ephemeris:

$$\text{Max} = \text{JD } 2447883.2437 + 0^{d}.145785\ E.$$

HD 18878 keeps its period during all the time of our observations covering more than 2600 pulsation cycles (Fig. 1).

Nevertheless we want to pay attention to unusual for Delta Scuti stars features seen on JD 2447882 (Fig. 2). Along with smooth variations in V, B, R, sudden peaks were seen in the W light curve and also in the W-B colour curve on this night. These peculiarities were observed near the time of light minima on V, B, R light curves. The peak in W-B colour curve is similar to those well known among RRab-type stars. For example, Fig. 3 shows V and U-B curves of the RRab-type star X Ari ($P=0\overset{d}{.}651$, strong metal deficiency) from Preston (1961). Another peculiarity mentioned (peak in W light curve) has no analogies among pulsating stars at all.

One can of course speculate on the presence of the strong shock wave phenomenon in HD 18878 like in RRab-type stars, but first of all further observational confirmation is needed.

M.S. FROLOV

Astronomical Council
USSR Academy of Sciences
Moscow, USSR

A.V. KUSAKIN, A.V. MIRONOV, V.G. MOSHKALEV

Sternberg State Astronomical Institute
Moscow, USSR

References:

Khaliullin, Kh.F., Mironov, A.V., Moshkalev, V.G.: 1985, Astrophys. Space Sci., 111, 291.

Preston, G.W.: 1961, Astrophys. J., 134, No. 2, 633.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3532

Konkoly Observatory
Budapest
29 October 1990
HU ISSN 0374 - 0676

ON THE NATURE OF THE CATACLYSMIC VARIABLE V 426 OPHIUCHI

Previous photometric observational series of V 426 Oph led the authors to characterize it as "ex-nova" or as "nova-like" (Meinunger 1967; Beyer 1977; Shugarov 1980, 1983), after the earlier classification as RW Aurigae type (Hoffmeister 1949) had been discarded by Herbig (1960) because of the presence of the Balmer series and of He I in emission over a structureless continuum. Since the He I emission and parts of the previous light-curves are typical for dwarf novae, we decided to investigate the object on all suitable Sonneberg plates.

1676 observations on exposures of the Sky Patrol (SSP) and 255 observations on plates of the two 40 cm astrographs (time interval 1931...1988) could be gained. Our pg. magnitude system is based on the B system of Shugarov (1983). Pronounced standstills in intermediate magnitude could not be observed. Remarkable, however, is the presence of two different minimum levels ($12^{m}_{.}90$ and $13^{m}_{.}45$), which follow each other in an obviously irregular manner. Eruptions are frequent; their average height and their breadth (at a level of $12^{m}_{.}0$) are $11^{m}_{.}5$ and 4 days, respectively. From the latter quantity a mean cycle length of $\bar{C}$ = 33 days (SSP) can be derived by statistical methods, for instance according to Wenzel and Richter (1986).

What is important: On the average the cycle length depends on the magnitude of the minimum from which the eruptions ascend. This effect can be easily found already in the visual light-curve of Beyer (1977): Compare for instance the series of 1951 - minimum 12^{m} vis., $\bar{C}$ = 21 days, and 1952 - minimum 13^{m}, $\bar{C}$ = 42 days. Fig. 1, which is drawn on the basis of a concerted series of four-minute exposures with the GB astrograph, also

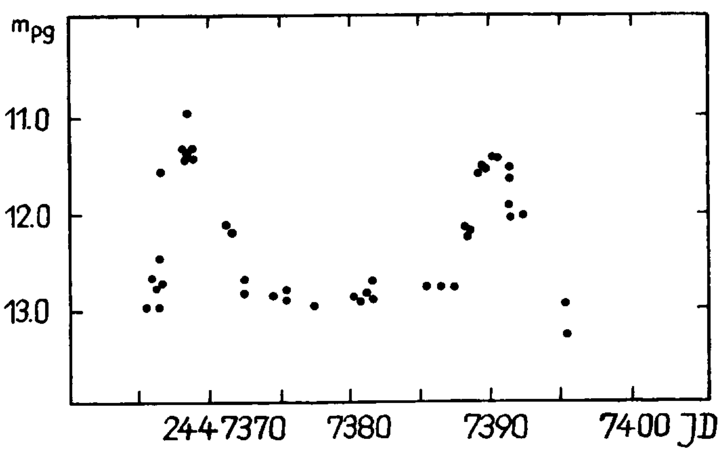


Figure 1

shows a good example for a short cycle length connected with a high level of the minimum (C = 22 days, minimum = $12^m.9$). In spring 1957 5 eruptions follow each other with a mean cycle length of 13 days and a minimum brightness of $12^m.8$; on the other hand there are numerous intervals of 25 to 40 days between eruptions, and the accompanying minimum state is around $13^m.5$. Also the photoelectrically determined curve of Shugarov (1983) seems to show the short value of C $\approx$ 16 days at a minimum level of B = $12^m.9$.

Orbital period (0.285 days, Hessman 1988), amplitude ($\approx$ 2 mag) and mean cycle length (33 days) fit into the relationships governing these quantities of dwarf novae and found by Richter and Bräuer (1989).

We suppose that V 426 Oph is an SS Cygni star which can switch between stronger and lower mass-transfer rates. Hessman (l.c.) and Szkody/Mateo (1988) observed the object in the upper minimum level, as we can see from the brightness data given by them. They found an unusually high transfer rate and that (at least in the UV) a large part of the brightness comes from the accretion disc. The shortening of the cycle length (see above) in this "upper state" is also typical for a higher mass transfer.

Here possibly a single star demonstrates us (at least qualitatively) what Vogt (1981) considered as a statistical property of the group of the dwarf novae as a whole, namely that the relationship amplitude/cycle length should be replaced by the relationship minimum luminosity/cycle length.

We thank Mr. G. Hacke and Mr. K. Heiland for nonschedule exposures and Dr. G.A. Richter for stimulating discussions.

W. WENZEL and E. SPLITTGERBER
Sternwarte Sonneberg
Zentralinstitut für Astrophysik der
Akademie der Wissenschaften
Deutschland

References:

Beyer, M., 1977, Veröff. Remeis-Sternwarte Bamberg 12,no.123, p.2
Herbig, G.H., 1960, Astrophys. J. 131,p.632
Hessman, F.V., 1988, Astron. Astrophys. Supp. 72,p.515
Hoffmeister, C., 1949, Astron. Nachr. 278,p.24
Meinunger, L., 1967, Mitt. Veränderl. Sterne 4,p.69
Richter, G.A., Bräuer, H.-J., 1989, Astron. Nachr. 309, p.416 (Fig. 3)
Shugarov, S. Yu., 1980, Astron. Tsirk. no. 1113
Shugarov, S. Yu., 1983, Pis'ma Astron. Zhurn. 9,p.31
Szkody, P., Mateo, M., 1988, Publ. Astron. Soc. Pacific 100, p.1111
Vogt, N., 1981, Mitt. Astron. Gesellschaft 57,p.79
Wenzel, W., Richter, G., 1986, Astron. Nachr. 307,p.209

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3533

Konkoly Observatory
Budapest
29 October 1990

HU ISSN 0374 - 0676

Differential photoelectric photometry of the δ Scuti star AV Ceti

AV Ceti (HR 401, m_v=6.02, Sp:F0V) was first reported as a short period variable star by Jørgensen et al. (1971). These authors, with three short nights of photoelectric observations detected a clear variation with a V amplitude of $0.^m02$ and estimated an approximate period of $0.^d07$.

The observations were carried out at Observatorio Astronómico Nacional (OAN) in San Pedro Mártir, Baja California, México, with the V Johnson filter on the nights of 23, 24, 28 and 29 of September, 1984. A pulse-counting single channel photometer and a dry-ice cooled 1P21 photomultiplier attached to 0.84 m telescope were used. The comparison stars were HR 404 and HR 444. Each observation consisted at least of 5 integrations of 10 seconds of the star followed by one 10-seconds integration of the sky. The average time between successive observations of the variable star was 6 minutes.

Table I lists the differential photoelectric photometry obtained for AV Cet minus HR 404. These differences plotted as a function of time are shown in Figure 1, the solid line was calculated from the obtained frequencies. The photometric behaviour of the comparison stars was highly constant, the sigma for the difference C_2 - C_1 was $\leq 0.^m005$, for the nights of 23, 28 and 29 of September. Figure 1 shows that the amplitude of the variation is similar to that reported by Jørgensen et al. (1971). The light variation as a δ Scuti star is confirmed for AV Ceti.

The Fourier analysis carried out to our data (López de Coca et al., 1984), showed a fundamental frequency at 14.5930 c/d, thus, a period of $0.^d0685$, which is also similar to that reported by Jørgensen et al. (1971). Once the data were prewhitened for this frequency, in the power spectrum, there appeared a frequency at 19.1862 c/d, but however more data are needed to confirm this result.

Using the photometric calibration (López de Coca et al., 1990) and the indices given by Hauck and Mermilliod (1985), we estimated the following physical parameters for this star: $M_{bol} = 2.04$, $\log T_e = 3.894$ and $\log g = 4.02$. With these values, we can calculate the pulsational constant Q with the classical Petersen and Jørgensen (1972) formula, thus, Q = 0.032 for the predominant period implying pulsation in the fundamental mode. The second frequency would give Q = 0.024 which would correspond to the first overtone. The ratio of the two periods is 0.76, in good agreement with the expected theoretical value (Petersen, 1976; Stellingwerf,

TABLE I.- Differential photometry of AV Ceti in the V filter.

HJD	ΔV	HJD	ΔV	HJD	ΔV	HJD	ΔV
2445966. +		2445967. +		2445971. +		2445972. +	
0.821	0.293	0.786	0.270	0.812	0.294	0.783	0.300
0.824	0.294	0.790	0.284	0.816	0.293	0.786	0.289
0.828	0.291	0.795	0.295	0.820	0.291	0.791	0.297
0.832	0.293	0.796	0.272	0.823	0.293	0.794	0.303
0.835	0.293	0.798	0.296	0.827	0.294	0.798	0.296
0.839	0.286	0.812	0.302	0.830	0.294	0.801	0.285
0.842	0.284	0.815	0.284	0.833	0.294	0.805	0.291
0.845	0.291	0.819	0.284	0.837	0.294	0.808	0.288
0.848	0.300	0.822	0.308	0.840	0.293	0.813	0.290
0.854	0.300	0.826	0.304	0.847	0.296	0.816	0.290
0.857	0.304	0.830	0.298	0.851	0.295	0.820	0.294
0.860	0.301	0.834	0.300	0.854	0.294	0.824	0.293
0.864	0.304	0.838	0.290	0.858	0.298	0.827	0.303
0.867	0.301	0.843	0.288	0.861	0.295	0.831	0.302
0.871	0.304	0.846	0.279	0.865	0.296	0.834	0.296
0.875	0.298	0.850	0.295	0.868	0.297	0.838	0.305
0.879	0.302	0.854	0.293	0.872	0.292	0.842	0.300
0.882	0.298	0.863	0.273	0.876	0.292	0.845	0.300
0.886	0.302	0.867	0.287	0.879	0.294	0.849	0.303
0.889	0.297	0.870	0.292	0.882	0.293	0.858	0.287
0.893	0.298	0.874	0.299	0.886	0.290	0.861	0.292
0.896	0.296	0.878	0.288	0.890	0.290	0.866	0.290
0.899	0.289	0.882	0.302	0.894	0.291	0.868	0.291
0.902	0.289	0.889	0.314	0.902	0.293	0.872	0.290
0.906	0.289	0.893	0.284	0.906	0.296	0.876	0.296
0.908	0.290	0.896	0.302	0.910	0.295	0.880	0.304
0.912	0.287	0.899	0.288	0.913	0.295	0.884	0.299
0.915	0.290	0.903	0.276	0.918	0.293	0.887	0.299
0.918	0.291	0.907	0.296	0.921	0.296	0.891	0.299
0.922	0.292	0.912	0.290	0.925	0.298	0.894	0.300
0.925	0.297	0.915	0.290	0.929	0.301	0.898	0.299
0.928	0.299	0.919	0.288	0.932	0.300	0.901	0.295
0.931	0.298	0.922	0.290	0.936	0.303	0.905	0.293
0.934	0.300	0.926	0.287	0.941	0.303	0.908	0.292
0.937	0.299	0.930	0.293	0.945	0.297	0.912	0.292
0.940	0.296	0.934	0.292	0.949	0.294	0.916	0.290
0.944	0.302	0.938	0.299	0.952	0.292	0.919	0.293
0.946	0.301	0.942	0.291	0.956	0.295	0.926	0.296
0.950	0.300	0.946	0.302	0.959	0.290	0.929	0.298
0.953	0.299	0.949	0.306	0.963	0.288	0.932	0.296
0.957	0.293	0.952	0.303	0.966	0.287	0.936	0.296
0.960	0.287	0.957	0.300	0.970	0.294	0.940	0.294
0.964	0.286	0.960	0.301	0.977	0.294	0.943	0.296
0.967	0.283	0.965	0.300	0.981	0.291	0.946	0.297
0.971	0.281	0.968	0.299	0.985	0.294	0.950	0.296
0.974	0.282	0.972	0.292	0.988	0.292	0.953	0.302
0.978	0.289	0.976	0.293	0.992	0.299	0.957	0.296
0.982	0.293	0.980	0.294	0.996	0.303	0.960	0.294
0.985	0.294	0.984	0.297	1.000	0.300	0.963	0.298
0.989	0.298	0.987	0.304	1.003	0.304	0.967	0.294
0.994	0.302	0.990	0.297	1.007	0.299	0.970	0.296
0.998	0.304	0.993	0.299	1.010	0.300	0.974	0.305
1.002	0.301	0.997	0.293			0.977	0.305
1.006	0.300					0.981	0.302
1.009	0.299					0.984	0.302
1.013	0.300					0.988	0.302
						0.992	0.292
						0.996	0.292
						0.999	0.290
						1.003	0.285

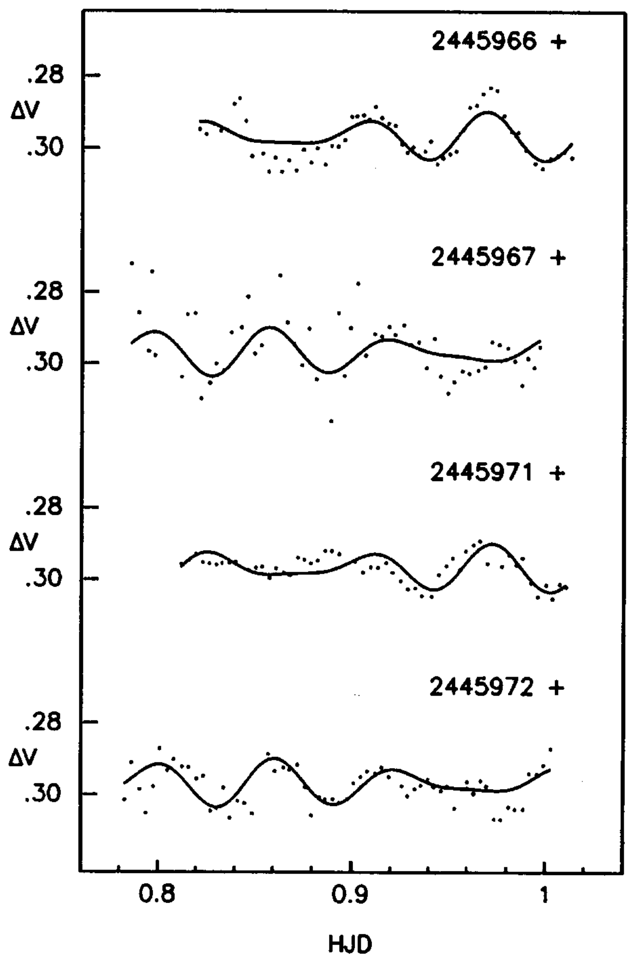


Figure 1

1979) for the fundamental and first overtone. Of course, more and continuous observations are needed for this star in order to detect this possibility.

ACKNOWLEDGMENTS.- This work is part of a program collaboration between the Instituto de Astrofísica de Andalucía (IAA), Spain and the Instituto de Astronomía, UNAM, México and it was supported by the Dirección General de Investigación Científica y Técnica (DGICT) under project PB0310. One of us (SGB) acknowledges the economic support of Ministerio de Educación y Ciencia (Spain) and the IAA.

S.F. GONZALEZ-BEDOLLA[1]

A. ROLLAND[2]

E. RODRIGUEZ[2]

P. LOPEZ DE COCA[2]

(1)Instituto de Astronomía, UNAM, México.

(2)Instituto de Astrofísica de Andalucía.

Granada, Spain.

REFERENCES

Hauck, B. and Mermilliod, M. 1985, Astron. Astrophys. Suppl. Series. 60, 61.

Jørgensen, H.E., Johansen, K.T., Olsen, E.H. 1971, Astron. Astrophys. 12, 223.

López de Coca, P., Garrido, R. and Rolland, A. 1984, Astron. Astrophys. Suppl. Series. 58, 441.

López de Coca, P., Rolland, A., Rodríguez, E. and Garrido, R. 1990, Astron. Astrophys. Suppl. Series. 83, 51.

Petersen, J.O. and Jørgensen, H.E. 1972, Astron. Astrophys. 17, 367

Petersen, J.O. 1976, in IAU Colloquium, No. 29, Multiple Periodic Variable Stars (Budapest), p. 195.

Stellingwerf, R.F. 1979, Astrophys. J. 227, 935.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3534

Konkoly Observatory
Budapest
31 October 1990

HU ISSN 0374 - 0676

FIRST SYNTHETIC SOLUTION FOR THE W UMa SYSTEM PP LACERTAE

Variability of PP Lac was discovered by W.J. Miller on photographic plates taken in 1948-1955 at the Castel Gandolfo Observatory (Rome). Miller and Wachmann (1971) proposed a type EW or RR for this star, and found a photographic amplitude of 0.9 magnitudes (11.1 to 12.0).

Figer and Rolland (1976-1977), on the basis of visual observations, classified this star as an EW-type eclipsing variable and found a period of 0.4011 days.

Recently Dumont and Maraziti (1990) were able to obtain photoelectric photometry of this star at the Jungfraujoch Observatory confirming the EW type as well as the photometric period (see Maraziti (1990) and Dumont and Maraziti (1990) for further details).

I have processed their B and V photoelectric observations in order to obtain the first orbital solution of this binary system. The light curve solution was obtained in time domain making use of a light curve synthesis computer code written by the author, fitting classical Roche model on the observations by optimization techniques. Any trial light curve was computed by direct numerical integration using a method similar to the procedure described in Rucinski (1973) and Lucy (1968). The adopted optimization procedure is of pattern search type (like the classical Hooke-Jeewes algorithm) with some stochastic step-correction rules adopted in order to increase computational efficiency. Such (more modern) optimizing procedure performs better than classical differential correction methods both in convergence speed and in robustness.

Despite the non-complete coverage of the light curve, the amount of information included in the available observations was sufficient to ensure a very fast convergence of the optimization procedure as well as a stable photometric solution in both colours. The two distinct photometric solutions, reported in Table I, are in excellent agreement with each other confirming the good quality of the available data.

The obtained model shows a W UMa type binary system with nearly equal

Table 1: Model for PP Lac

		B colour	V colour
Mass ratio	q :	.61 + .01	.60 + .01
Fill-Out parameter	f :	.57 + .02	.62 + .02
Orbital Inclination	i :	86.0 + .2	82.4 + .3 (degrees)
Radius of the primary star	r1:	.459 + .004	.455 + .005
Radius of the secondary star	r2:	.373 + .003	.367 + .004
Fractional Luminosity	L1 :	.626	.627
Fractional luminosity	L2 :	.374	.373
Temperature Ratio	T2/T1 :	.985	.987

temperature, a mass ratio q=.6 and fill-out parameter also about .6, only the orbital inclination results for the solution of the B and V light curve are in slight disagreement.

The final average RMSs of the optimal solutions (intensities) are .0086 an .010 for the B and V light curve respectively.

The present solution is the first one and must be regarded as preliminary.

This star is a very interesting binary system needing accurate additional photometry, therefore additional observing efforts are planned at the GEOS in the near future.

A. GASPANI[1,2]

1 Osservatorio Astronomico di Brera
Via Brera, 28
20121 Milano (Italia)

2 GEOS
3, Promenade Venezia
F-78000 Versailles

References:

Dumont, M., Maraziti, A.: 1990, IBVS No.3478.
Figer, A., Rolland, R.: 1976, GEOS NC 142.
Figer, A., Rolland, R.: 1977, IBVS No.1231.
Lucy, L.B.: 1968, Ap. J., 153, 877.
Maraziti, A.: 1990, GEOS EB 17.
Miller, W.J., Wachmann, A.A.: 1971, Ricerche Astronomiche, 8, No.12.
Rucinski, S.M.: 1973, Acta Astronomica, 23, No.2.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3535

Konkoly Observatory
Budapest
31 October 1990
HU ISSN 0374 - 0676

1990 BVR PHOTOMETRY OF XY UMa

The close binary XY UMa (= + 55° 1317, SAO 27143) is No. 69 in the catalogue of chromospherically active binaries of Strassmeier *et al.* (1988). Geyer has made synoptic optical observations since 1955. From coordinated x-ray and optical observations, Bedford *et al.* (1990) concluded that the G primary star emits the soft x-ray flux, which showed a clear primary eclipse. The coronal plasma has an enhanced component on the side facing the primary star; a photospheric active region underlies a similar span in longitude. With the launch of ROSAT, new x-ray observations are possible for XY UMa. Consequently, we have decided to continue our optical photometry at Capilla Peak Observatory (CPO).

Our new observations were done on the nights of March 3 and 4 and April 16, 1990 UT. We followed a similar procedure as for our 1988 data (Zeilik *et al.*, 1988), except that we have a new filter set (Beckert and Newberry, 1989) for our CCD system (Laubscher *et al.*, 1988). The effective wavelengths are: *B*, 438.5 nm; *V*, 559.4 nm; and *R*, 680.4 nm. We used Geyer's comparison star (SAO 27139). The observations were reduced with a software mask with a diameter of 20 arcsec. Exposures were chosen so that S/N > 100. Phases were calculated from the ephemeris in Strassmeier *et al.* (1988).

Figures 1 through 3 give the *B*, *V* and *R* delta magnitudes in the instrumental system. In Figure 4, we compare the observations (open circles) to an eclipsing binary model fit (solid line), following the procedures of Budding and Zeilik (1987); the units are normalized intensity. The difference between these two curves defines the distortion wave for the system at this epoch. We then applied a circular, black (T = 0) spot model to the distortion wave. We found that the data were not precise enough to extract a determinate solution for latitude in a four-parameter fit. Therefore, once we found a preliminary longitude value, we fixed this parameter and searched χ^2 solution hyperspace for a latitude

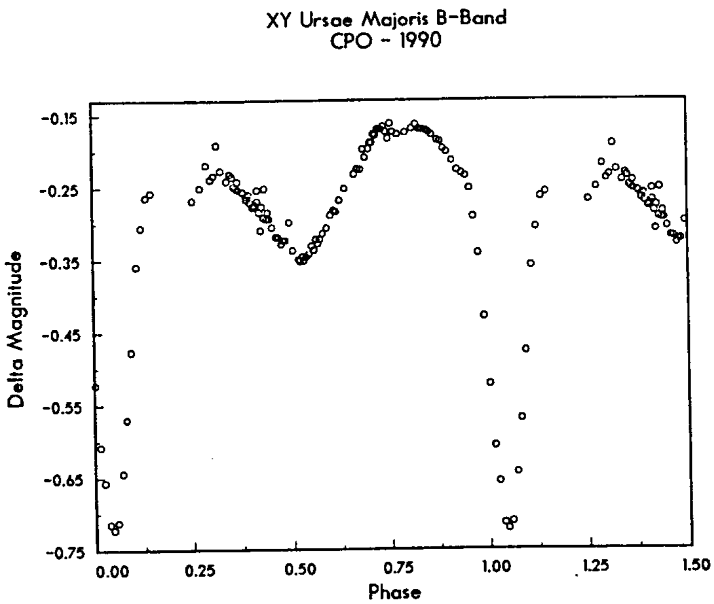


Figure 1

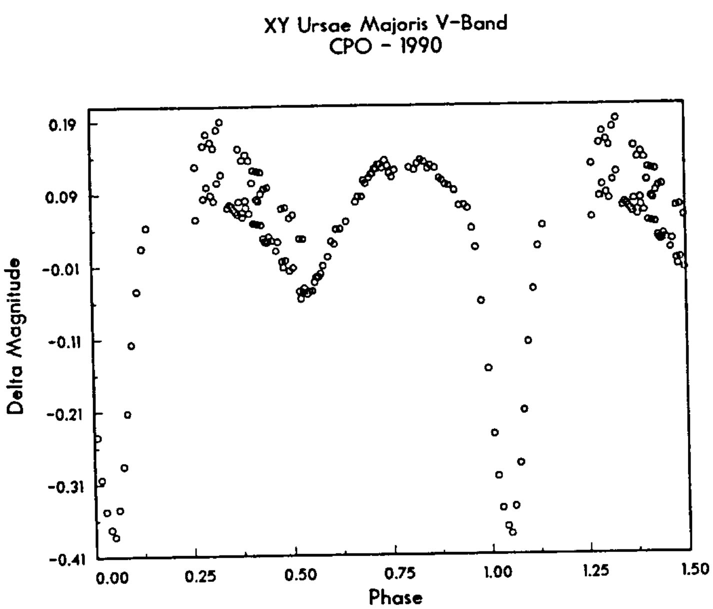


Figure 2

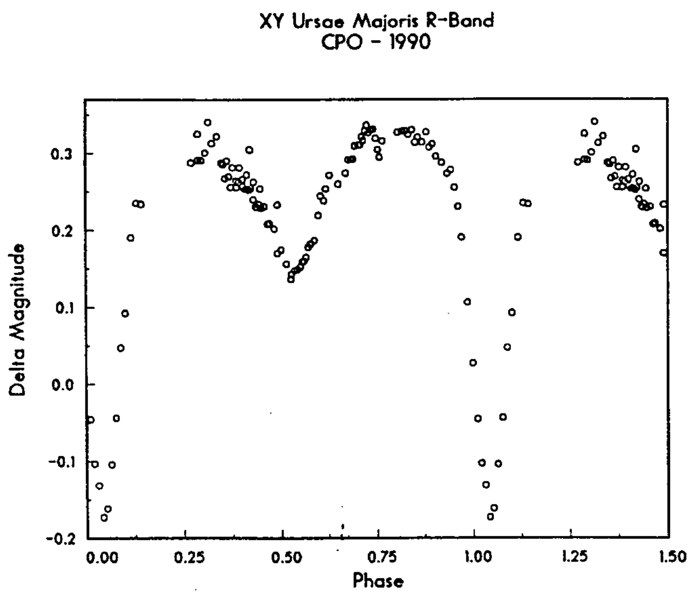


Figure 3

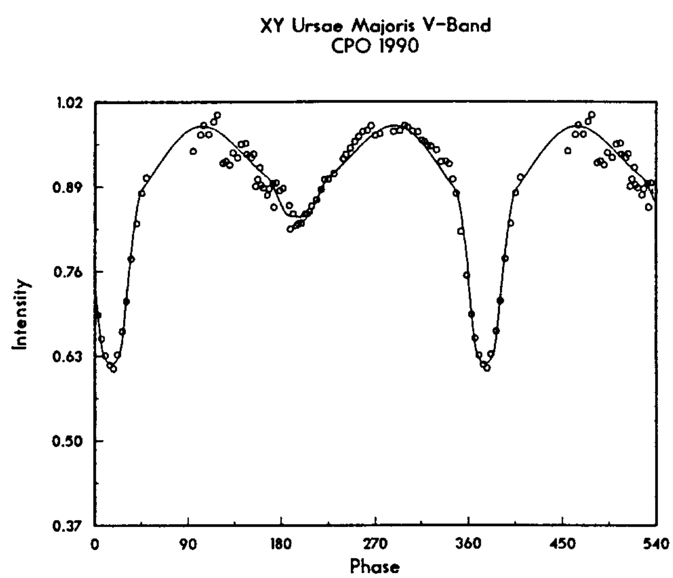


Figure 4

value. We found a value of near 45 degrees at *V* band. We then fixed the latitude at 45° and found the following spot parameters:

Wavelength	Longitude	Radius	x^2
B	113°±5.2°	15.9°±0.7°	93.8
V	108°±14°	8.9°±1.0°	182.4
R	126°±7.4°	12.2°±0.6°	110.5

We attempted to use the *V* and *R* observations to calculate a spot temperature; however, the overall errors (± 0.04 intensity units) were too large to do so. After our fits with one spotted region, we "cleaned" the original light curves of the maculation effects and attempted to find another active region. We were unable to find another one.

In our 1987 data (Heckert and Zeilik, 1988), we found one spotted region at a longitude = 269°±6°, a latitude of 40° ± 36°, and a radius of 9.2° ± 4.0° at *V* band. These fell into the active longitude belt near the 270° quadrature longitude. In 1990, we now have the active region in the active longitude belt near 90°, which upholds the trends for the short-period systems. Their primary activity signature involves a switching of activity between the two active longitude belts.

MICHAEL ZEILIK, CECILIA DE BLASI,
SHAWN GORDON and MICHAEL LEDLOW
Capilla Peak Observatory
Institute for Astrophysics
University of New Mexico
Albuquerque, New Mexico 87131 USA

REFERENCES:

Beckert, D.C. and Newberry, M.V., *Pub. Astron. Soc. Pacific*, **101**, 849-858 (1989).
Bedford, D.K., Jeffries, R.D., Geyer, E.H., and Vilhu, O., *Mon. Nat. R. Astr Soc.* 243, 557-564 (1990).
Budding, E. and Zeilik, M., *Ap.J.*, **319**, 827-835 (1987).
Heckert, P. and Zeilik, M., *IBVS* No. 3253 (1988).
Laubscher, B., Gregory, S., Bauer, T., Zeilik, M., and Burns, J., *Pub. Astron. Soc. Pacific*, **100**, 131-136 (1988).
Strassmeier, K.G., Hall, D.S., Zeilik, M., Nelson, E., Eker, Z., Fekel, F.C., *Astron. Astrophys. Suppl. Ser.*, **72**, 291-345 (1988).
Zeilik, M., Cox, D., De Blasi, C., Ledlow, M., Rhodes, M., and Williams, T., *IBVS*, No. 3200 (1988).

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3536

Konkoly Observatory
Budapest
1 November 1990

HU ISSN 0374 - 0676

The X-Ray Source HD 197010 is an Eclipsing Binary

From an examination of the Einstein Observatory Extended Medium Sensitivity Survey, Fleming et al. (1989) compiled a list of seven stars expected to be W UMa systems. In a continuing investigation of these systems we have observed six of them. We have published results on 1E1654.0+3515 (Robb 1989), 1E1806.1+6944 (Robb and Scarfe 1989), 1E2119.7+1655 (Robb 1990) and reports on others are in preparation. This is a report of our observations of another of the stars on the list, namely HD 197010 = SAO 144692 = BD -1 4025 = 1E2038.3-0046. Its position at Right Ascension $+20^h38^m20^s.2$ and Declination $-00^\circ46'26''$ (Equinox 1950), brightness of 9.35 in the V band and spectral class of F8 were given by Fleming et al. (1989). A finder chart adapted from Papadopoulos et al. (1980) is given for this star in figure 1.

HD 197010 was observed using the 0.5 meter reflector of the Climenhaga Observatory at the University of Victoria on two nights in November 1989 and fourteen in August and September 1990. Computer control of the telescope allows us to point it at each of the stars at the beginning of the night and then leave it to follow a program of observations until the star reaches too large an airmass. Due to the close similarity of the variable, comparison and check stars in both position and color, mean extinction and transformation coefficients were used to correct the differential magnitudes to the Johnson V and Cousins R system (Landolt 1983). The observations of the variable star were bracketed by observations of the comparison star SAO 144708 = BD -00 4068 = HD 197105, whose constant brightness was monitored with 471 observations of the check star, SA 112 1242 = SAO 126119 = BD -00 4072 = HD 197232 (Landolt 1983). The mean check star minus comparison star magnitude was 0.360 ± 0.028 in V and 0.348 ± 0.029 in R. The errors are standard deviations about the mean, and assure the constancy of the comparison and check stars at this level, even though the uncertainties are unusually large because of the stars' low declination and the consequent bright sky background. Means of each of the fifteen nights data were calculated and the standard deviation of the nightly means was 0.009 in the V and R bands, assuring the night to night variations of the stars and the system were less than this amount.

An initial estimate of the period was found using a program based on the Phase Dispersion Minimization method of Jurkevich(1971). Plotted in figure 2 is the average standard deviation of forty phase bins as a function of the inverse period. The deep minimum at 1.41 inverse days indicates the orbital period of the system, and the shallow minima are one-day aliases and simple fractions of the real period. Inspection of a similar plot using 60 phase bins and a finer spacing of trial periods indicates a period of 0.71017 ± 0.00015 days.

Times of minimum brightness were found using a program based on the method of Kwee and Van Woerden (1956) and checked using the tracing paper method. Observations in each color were treated individually, but since there were no significant differences between the times obtained, they were combined in a mean, weighted inversely by the error in each color's determination. The heliocentric times of extrema based on all points within 0.04 days of the extrema are given in Table 1. The asymmetrical maxima shown below indicate that the minima may also be asymmetrical making the times of minimum light a function of the range of phase considered. The period found from the four times of minimum light was 0.7105 ± 0.0007 days with residuals of about seven minutes. The

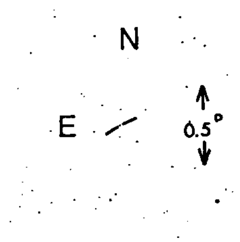


Figure 1. - Finder chart for X-Ray source, HD 197010; centered on Right Ascension 20:38:20.2 and Declination -00:46:26 (1950.0).

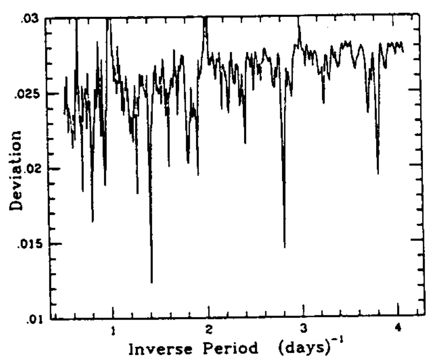


Figure 2. - Average standard deviation of forty bins versus inverse period.

Table I.
Heliocentric Julian Date of Minima - 2440000.0.

Primary Minima	Secondary Minima
8138.7196	8139.7936
13	15
8140.8511	8144.7621
4	5

points from the two nights in November 1989 were from the eclipse parts of the light curve, but could not supply a time of minimum. However for these points to be on the light curve the period had to be adjusted. The ephemeris best fitting the light curve is found to be:

$$\text{Helio. J. D. of Primary Minimum} = 2448140.8505(24) + 0.71017(7)E.$$

This period is too long to be in good agreement with the period-color relation of Eggen (1967) for contact binaries.

Due to the rather large errors in our observations, the observations have been combined into the sixty V and R band normal points plotted in figures 3 and 4. The error bars represent one standard deviation of the mean. This curve clearly shows the variation expected for an eclipsing binary system. The difference in depth of the minima show that the two stars are of different temperature

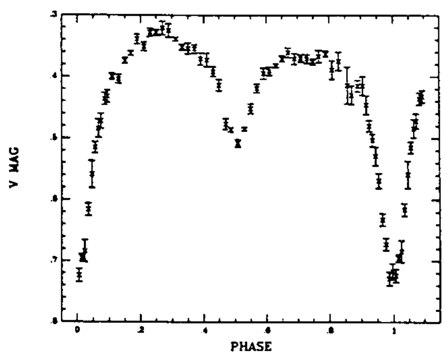


Figure 3. - V filter light curve normal points plotted with PHASE = (JULIAN DATE - 2448140.8505) / 0.71017.

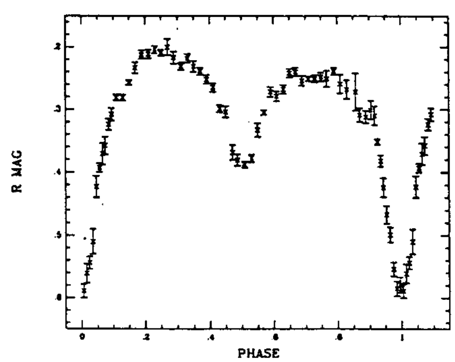


Figure 4. - R filter light curve normal points plotted with PHASE = (JULIAN DATE - 2448140.8505) / 0.71017.

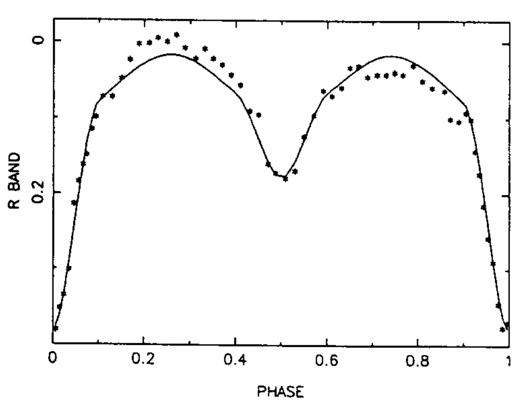


Figure 5. - R band normals points plotted with model light curve assuming both stars fractional radii are 0.31, hot star's temperature is 6300 degrees, cool star's temperature of 4800 degrees, mass ratio of 0.7 and an orbital inclination of 68 degrees.

and thus not in good thermal contact. The large difference in the brightness of the maxima showed no obvious variation from the first of August until the end of September. The (V-R) color curve shows no obvious trends.

A computer modelling program written by G. Hill (1979) was used to find approximate elements of the system. From the spectral classification of F8 from (Fleming et al.1989), we assumed a temperature of 6300 degrees Kelvin and a convective envelope with full limb darkening. The atmospheres were assumed to be black bodies. Three radial velocities are available from Fleming et al. (1989) and allow us to estimate the amplitude of the radial velocity of the bright star to be about 110 kilometers per second, but give no information as to the mass ratio of the system. Since the spectrum shows only the lines of the bright star, we assumed a mass ratio of 0.7. As shown in figure 5 the best match was found for both stars having fractional radii of 0.31, an orbital inclination of 68 degrees and a temperature for the secondary of 4800 degrees. Both stars are inside their Roche lobes for mass ratios greater than about 0.6. With this assumed velocity the primary star is roughly the accepted mass and radius of a F8 dwarf, but the seconday star is much too large for its mass and temperature. The rotational velocity from this model is consistent with the observation of Bergoffen et al. 1988. These elements must be regarded as very preliminary values, since the observed light curve shows a large asymmetry in the brightness of the maxima and the mass ratio is unknown.

The X-ray source HD 197010 is an eclipsing system with a period of 0.710 days, a depth of primary minimum of 0.4 magnitudes, and a large asymmetry of the maxima. This type of asymmetry is generally attributed to star spots, which may also be the source of the observed X-Rays (Fleming et al.1989). More spectroscopic observations of this system will be important to find the component masses and mass ratio. Further photometric observations will be important to refine the orbital period, to permit a more detailed solution than has been attempted here, and to observe any migration of the asymmetry in the maxima that may occur.

R. M. ROBB
F. W. DEAN
C. D. SCARFE
Climenhaga Observatory
University of Victoria
Victoria, B.C., Canada

REFERENCES

Bergoffen, M. J., Stocke, J., Walter, F., and Fleming, T. A., 1988, PASP, 100, p736-740.

Eggen, O. J., 1967, Mem. Roy. Astr. Soc., 70, p111-164.

Fleming, T. A., Gioia, I. M. and Maccacaro, T., 1989, A. J., 98(2), p692-698.

Hill G., 1979, Pub. Dom. Astr. Obs. XV, 267.

Jurkevich, I., 1971, Ap. Space Sci., 13, 154.

Kwee, K. K. and Van Woerden, H., 1956, Bull. Astr. Inst. Neth., 12, p327.

Landolt, A. U., 1983, AJ 88(3), p439-460.

Papadopoulos C. and Scovil C., 1980, The True Visual Magnitude Photographic Star Atlas (Pergamon Press, Toronto, Canada) .

Robb, R. M., 1989, IBVS 3346.

Robb, R. M. and Scarfe, C. D., 1989, IBVS 3370.

Robb, R. M., 1990, IBVS 3430.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3537

Konkoly Observatory
Budapest
1 November 1990

HU ISSN 0374 - 0676

PHOTOELECTRIC OBSERVATIONS OF THE ALGOL-TYPE BINARY STAR RZ Oph

RZ Oph (BD +7°3832) is a long period (P=262 days) Algol-type binary star. Its components have been classified as F5Ib + K5Ib (Knee et al. 1986). Baldwin (1978) showed that the observed hydrogen emission lines originate in a flattened disk surrounding the F component and derived a model of the system with component masses of about 3.5 and 1.3 solar masses for the primary and secondary, respectively (while assuming the system inclination close to 90 degrees). The most controversial was his conclusion that the secondary component did not fill its critical Roche lobe. An alternative model, also on the basis of Baldwin observations, was worked out by Smak (1981) who assumed semidetached configuration of the system which led to i = 75. During the campaign suggested by Smak in 1981 several investigators obtained photometric observations of RZ Oph (Papousek and Vetesnik 1982, van Paradijs et al. 1982, Forbes and Scarfe 1984, Knee et al. 1986) The most recent model of RZ Oph was worked out by Knee et al. from their photometric and spectroscopic observations. They obtained a new radial velocity curve solution and derived the mass ratio of the system to be about 0.12. Their solution also supports the model with the secondary star being inside its critical Roche lobe. Olson (1987) summarized his efforts to obtain a complete uvbyI light curve of RZ Oph. He estimated the disk parameters by analyzing the eclipses of the F component by the disk and found the disk to be very large, filling or even overflowing the Roche lobe of the gainer. The disk temperature runs from 5600K to about 4400K at the edge of the disk. The light curve published by Olson is the most complete ever obtained but it is based on observations collected from 1981 to 1986 so the scatter due to long-term disk variations is very large. Since the light curve outside the eclipses should provide some information about the secondary star I decided to reobserve RZ Oph. In order to minimize the intrinsic variations of the light curve due to disc variations my attempt was to get a complete light curve of the system in the shortest possible time which for RZ Oph means one observing season. All observations were made with 0.6 m Cassegrain telescope equipped with a double-beam photometer (Szymanski and Udalski 1989) at the Mt.Suhora observatory, using a set of B and V filters close to the UBV Johnson-Morgan system. BD +6 3917 was used as a comparison star. Observations begun in September 1988 in order to cover the primary minimum which was predicted in October 1988 and were continued throughout 1989 to collect a complete light curve. Observations obtained in 1988 are presented in Fig. 1a and 1b, those collected in 1989 in Fig. 2a and 2b. The time of primary minimum determined from the observations made in 1988 is:

$$\text{Min I} = \text{JDhel} \quad 2447442.70 \pm 0.5$$

As one can see, in 1989 it was possible to obtain almost complete light curve of RZ Oph. Unfortunately, it is not possible to combine the observations made in 1988 and 1989 due to different depths of the primary minimum, observed in both filters (see Fig. 1 and 2). I have found no instrumental reasons which could account for these differences. Similar effect was reported by Olson and Hickey (1983). They found that the system observed in 1982 was dimmed by 0.03 to 0.1 magnitude in comparison with observations obtained by Baldwin, and it returned to the previous brightness level in only one orbital cycle.The light curve of RZ Oph exhibits light variations from night to night, but the most striking feature of the light curve, particularly if one compares it with the light curve of KU Cyg, another Algol-type binary with similar components F4I + K5III (Olson 1988), is the fact that the primary minimum is rather shallow. It might suggest that part of light constant with phase is present during all the period, also in the primary minimum. This would be either a third light in the system or, what seems to be more plausible, a considerable part of the disk light is still visible in the primary minimum. In 1989 the dips near the primary minimum were not as visible as in earlier observations reported by Olson, which implies that disk effects were less prominent in 1989. Spectroscopic observations made in 1989 (Olson 1989) show the double-peaked structure of

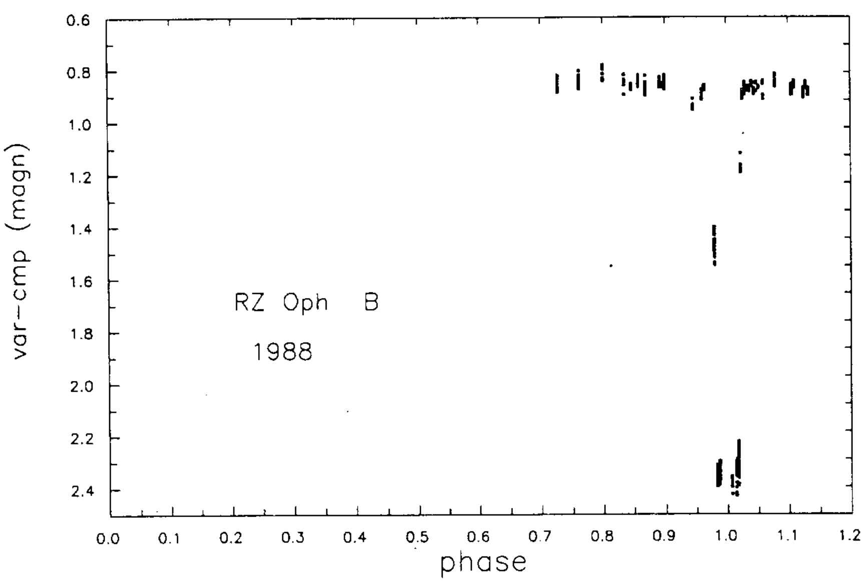


Figure 1a Observations of RZ Oph in B filter obtained in 1988.

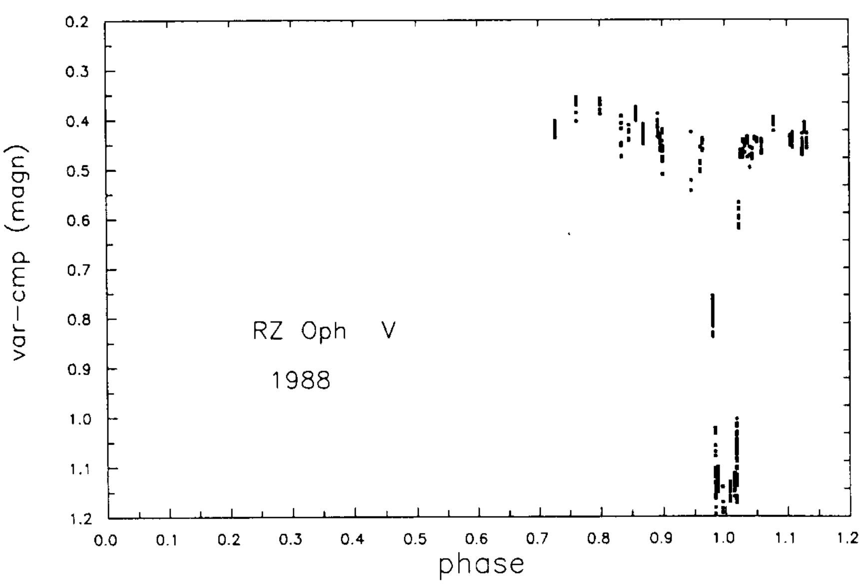


Figure 1b Observations of RZ Oph in V filter obtained in 1988.

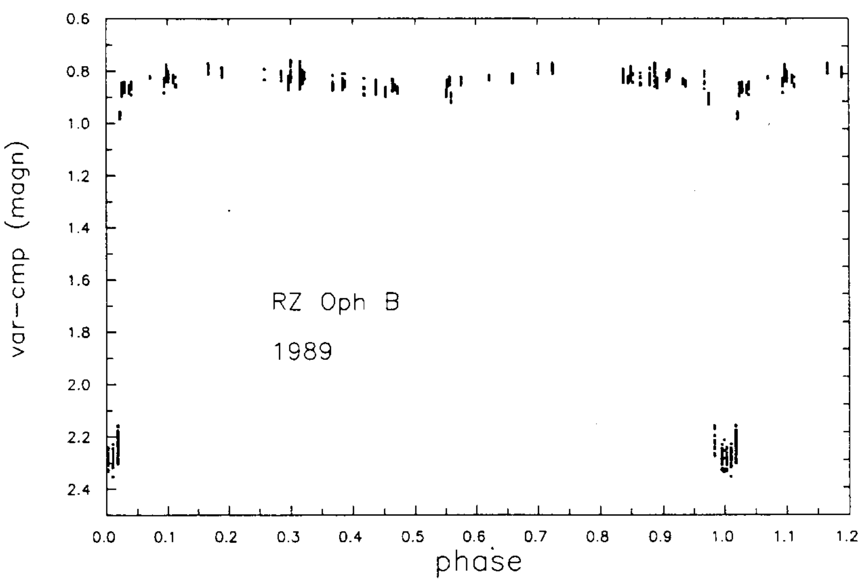


Figure 2a Observations of RZ Oph in B filter obtained in 1989.

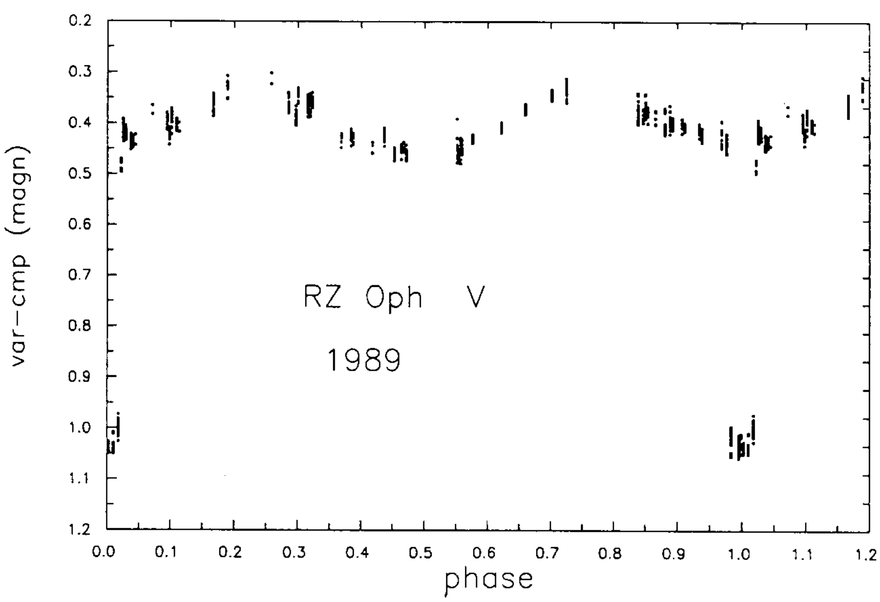


Figure 2b Observations of RZ Oph in V filter obtained in 1989.

hydrogen emission lines, evidently arising in a flattened disk around the primary component. The ellipticity effect is clearly visible in both filters what suggests that the secondary star can not be so deep inside its Roche lobe as it was obtained in the model of Knee et al., but rather fills or almost fills its critical Roche. This would also agree with conclusions obtained from the IUE observations reported by Plavec and Scarfe (1989) implying that the secondary must be distorted. A complete analysis together with parameters of a new model of RZ Oph obtained on the basis of the presented observations and those reported by Olson will be published in Acta Astronomica.

I would like to thank Professor J. Smak for suggesting the subject and to Professor J. Kreiner for generous amount of observing time at the Mt. Suhora observatory.
Several of the observations, were made by G.Pajdosz, J.Krzesiński and M.Dróżdż. This work has been supported by the grant RR I-11 from the Polish Ministry of Education.

S. ZOLA

Astronomical Observatory of the Jagiellonian University
Ul. Orla 171, 30-244 Cracow, Poland
Mt. Suhora Astronomical Observatory, Pedagogical University
Ul. Podchorazych 2, 30-084 Cracow, Poland

References.

Baldwin,B.C.,1978,Astroph.J.,226,937.
Forbes,D.,Scarfe,C.D.,1984,Publ.Astron.Soc.Pac.,96,737.
Knee,L.B.G. et al.,1986,Astron.Astropys.,168,72.
Olson,E.C.,Hickey,J.P.,1983,Astroph.J.,264,251.
Olson,E.C.,1987,Astron.J.,94,1309.
Olson,E.C.,1988,Astron.J.,96,1439.
Olson,E.C.,1989, priv. communication.
Papousek,J.,Vetesnik,M.,1982,I.B.V.S.,No 2070.
van Paradijs,J., et al.,1982,Astron.Astrophys.,111,372.
Plavec,M.,Scarfe,C.D.,1989,Space Science Reviews,50,p323.
Smak,J.,1981,Acta Astron.,31,25.
Szymański,M.,Udalski,A., 1989, Acta Astr.,39,1.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3538

Konkoly Observatory
Budapest
6 November 1990

HU ISSN 0374-0676

VARIABILITY OF THE DEPTH OF THE MINIMA OF THE DOUBLE SYSTEM HD 135421

BV Dra and BW Dra (ADS 9537, HD 135421) have been detected as eclipsing binaries by Batten and Hardie (1965).

Photometric observations by Wood (1970) Rucinski (1976) and Yamasaki (1979) have shown that they are normal W UMa systems. New photometric observations have been presented by Rovithis and Rovithis (1987) for the system. Dapergolas et al. (1989a, b) have also carried out BV photoelectric observations of BV Dra and BW Dra respectively.

These two eclipsing binaries were also observed from 16 May through 23 May 1990 with the 1.2m Kryonerion telescope and a single channel photon counting photometer. The photometer employs a high gain 9789QB phototube and conventional BV filters. Its output is fed directly to a microcomputer enabling rapid data access.

The data reduction is the standard one. The comparison star is for both cases BD +62° 1385 and the accuracy of observations is $\pm$0.02mag.

Table I lists the dates of observations and phases covered whereas Figures 1 and 2 summarize the results for B and V colours.

TABLE I

a) BV Dra

Date	Phase
16 May 1990	.27 - .09
18 May 1990	.0 - .76
22 May 1990	.58 - .78
23 May 1990	.27 - .02

b) BW Dra

Date	Phase
16 May 1990	.42 - .38
18 May 1990	.27 - .20
22 May 1990	.15 - .40
23 May 1990	.38 - .23

In Table II the times of minima and the O-C values are listed for the V and B bands respectively.

Times of minima are calculated using the method described by Kwee and van Woerden (1956) whereas the O-C values were determined from the following linear ephemeris.

BV Dra T= 2442878.372 +0.3500663E (Geyer et al. (1982)).

BW Dra T= 2442572.538 +0.2921671E (Geyer et al. (1982)).

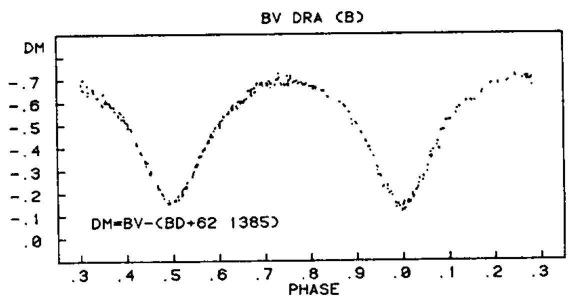


Figure 1a

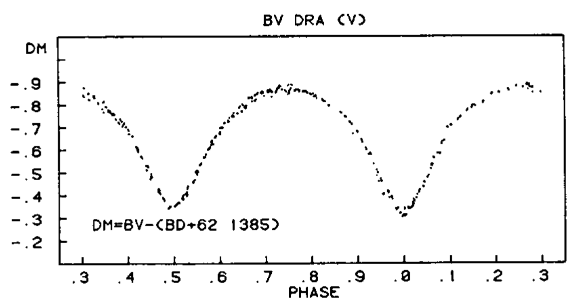


Figure 1b

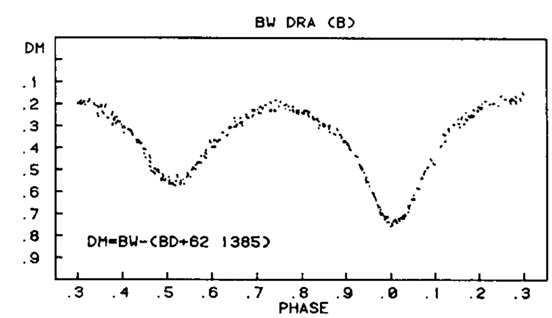


Figure 2a

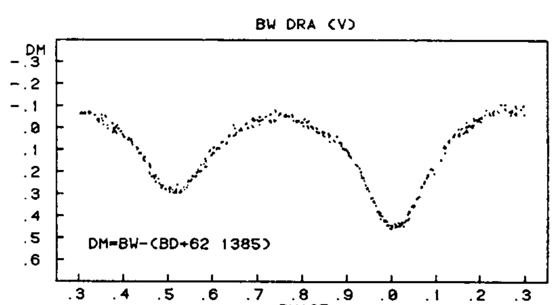


Figure 2b

Fig 1a, b shows the light curve of BV Dra for B, V colours respectively whereas Fig 2a, b are the same for BW Dra.

TABLE II

a) BV Dra

	V colour		B colour	
Type of minima	Heliocentric Jul. Day	(O-C) Phase	Heliocentric Jul. Day	(O-C) Phase
Secondary	2448028.3745	0.4982	2448028.3743	0.4977
	q.0001	q.0003	q.0001	q.0003
Primary	2448028.5489	0.9966	2448028.5491	0.9971
	q.0003	q.0008	q.0002	q.0006
Secondary	2448030.4756	0.5002	2448030.4752	0.4992
	q.0002	q.0007	q.0002	q.0006
Secondary	2448035.3758	0.4983	2448035.3759	0.4985
	q.0002	q.0007	q.0002	q.0005

a) BW Dra

	V colour		B colour	
Type of minima	Heliocentric Jul. Day	(O-C) Phase	Heliocentric Jul. Day	(O-C) Phase
Secondary	2448028.3251	0.516	2448028.3249	0.516
	q.0003	q.001	q.0003	q.001
Primary	2448028.4688	0.0083	2448028.4685	0.0072
	q.0001	q.0003	q.0002	q.0006
Secondary	2448030.37	0.5152	2448030.3705	0.517
	q.0002	q.0007	q.0005	q.001
Primary	2448030.5138	0.0075	2448030.5137	0.007
	q.0002	q.0006	q.0003	q.001
Secondary	2448035.3384	0.52	2448035.339	0.523
	q.0005	q.002	q.0005	q.002
Primary	2448035.481	0.0086	2448030.4812	0.0095
	q.0003	q.0009	q.0003	q.0009

From the Fig. 1a, b and Fig. 2a, b presented here it can be seen that BV Dra and BW Dra have symmetric light curves.

The differences between primary and secondary minima are ~0.18mag in B and ~0.17mag in V for BW Dra. From the observations presented previously by Dapergolas et al. (1989b), Rovithis and Rovithis (1987) and Geyer et al. (1982) it is found that the difference between primary and secondary minima is variable (see Table III) from year to year and doesn't change from colour to colour.

TABLE III

Differences between Primary and Secondary minima for BW Dra in B, V colours.

Date	B(mag)	V(mag)
1990	0.18	0.17
1989	0.11	0.1
1982	0.13	0.12
1981	0.07	0.07
1980	0.06	0.05

These differences between primary and secondary minima do not seem to exist for BV Dra.

A. DAPERGOLAS
National Observatory of Athens
Astronomical Institute
P.O. Box 20048
GR Athens 118-10
Greece

E. KONTIZAS and M. KONTIZAS
Laboratory for Astronomy and Solar Physics
NASA, Goddard Space Flight Center
Greenbelt
Maryland 20771
U.S.A.

References

Batten, A.H. and Hardie, R.H.: 1965, Astron. J. 70, 666.
Dapergolas, A., Kontizas, E. and Kontizas, M.: 1989a, IBVS no 3377.
Dapergolas, A., Kontizas, E. and Kontizas, M.: 1989b, IBVS no 3382.
Geyer, E.H., Hoffmann, M. and Karimie, M.T.: 1982, Astron. Astrophys. Suppl. Ser., 48, 85.
Kwee, K.K. and van Woerden, H.: 1956, Bull. Astr. Inst. Netherlands 12, 327
Rovithis, P. and Rovithis - Livaniou, H.: 1987, Astron. Astrophys. Suppl. Ser. 70, 63.
Rucinski, S.M.: 1976, IAU Symp. 73, 349.
Wood, D.B.: 1970, Bull. American Astron. Soc., 2, 357.
Yamasaki, A.: 1979, Astrophys. Space Sci., 60, 173.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3539

Konkoly Observatory
Budapest
8 November 1990
HU ISSN 0374 - 0676

An independent confirmation of rapid oscillations in the cool Ap star HD 12932

The V=10.3 Ap star HD 12932 is classified as Ap SrEuCr by Houk and Smith-Moore (1988), making it a good candidate for rapid oscillations. Weiss and Schneider 1990 (private communication and I.B.V.S., submitted) have just discovered it to be a rapidly oscillating Ap (roAp) star; in this bulletin, I report an independent confirmation of the detection of rapid oscillations.*

Photometry was obtained on three nights in Oct. 1990 with the Lowell 1.1-m John S. Hall telescope and the 0.8-m reflector in Johnson B. A total of over 7 hours of photometry was obtained over a time-span of 7 days. A periodicity analysis of the data was undertaken utilizing Kurtz' (1985) faster algorithm of the Deeming (1975) DFT technique. The figure shows a peak in the amplitude spectrum near 124 c/d (ν=1.44 mHz), corresponding to a period of about 11.6 minutes. A least-squares cosine fit to the data yields a best fit to the period 11.605 $\pm$ 0.003 minutes, with a semi-amplitude of 2.27 millimagnitudes.

I gratefully acknowledge the Lowell Observatory endowment for support of this research.

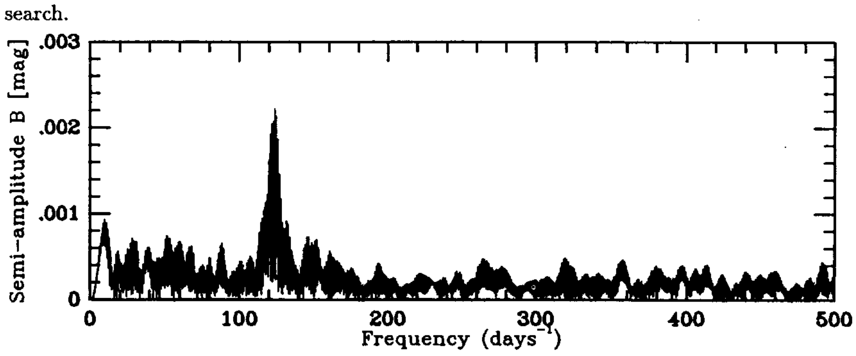


Figure 1

TOBIAS J. KREIDL
Lowell Observatory
Mars Hill Rd., 1400 West
Flagstaff, AZ 86001, U.S.A.

References

Deeming, T.J., 1975. *Astrophys. Space Sci.*, **36**, 137.
Houk , N., Smith-Moore, M., 1988. *Michigan Spectral Catalogue*, Vol. 4, Department of Astronomy, University of Michigan, Ann Arbor.
Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213**, 773.

* The discovery note has been published by Schneider and Weiss in the No. 3520 issue of the I.B.V.S. (Editors).

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3540

Konkoly Observatory
Budapest
12 November 1990
HU ISSN 0374 - 0676

AW UMa IS IN ACTIVE PHASE OF MASS TRANSFER

AW UMa (BD+30°2163 = HD 099946), a totally eclipsing A-type W UMa system has attracted much attention in recent years (cf. e. g. Rensing, Mochnacki and Bolton 1985; Srivastava et al. 1989; Liu et al. 1990; In't Zand, Heintze, Van't Veer, 1990), because this system is of great interest in the study of the evolution of W UMa systems. It has smallest known mass ratio (0.07 < q <0.08) among all binary stars. It exhibits probably the shallowest eclipses known for totally-eclipsing W UMa systems. It has very probably a space motion typical of an old disk population star (Eggen, 1967). Moreover, the system is easily observable because of its high apparent brightness ($V_{max} = 6^m.84$, $\Delta V = 0^m.24$). The system thus has been observed frequently, since its discovery in 1963 (Paczynski, 1964). It conforms very well to the overall properties of the A type contact systems: in addition to the small mass ratio, it has relatively early spectral type (F0-F2 by Paczynski 1964) and might have a rather large degree of contact (Hrivnak 1982). A variable O'Connell effect as slightly brighter primary or secondary maximum was reported by many observers (see e. g. Kalish 1965; Ferland and Mc Millan 1976, Hrivnak 1982). Although, there have been reported small light curve instabilities and one or two period changes (Dworak and Kurpinska 1975; Woodward et al. 1980; Srivastava and Padalia 1986) the system was known uncomplicated photometrically. In't Zand, Heintze, Van't Veer (1990) observed the system in 474, 579, 672, 781 and 871 nm wavelengths of the Utrecht Photometric System between 1983-1986. They found all the data lie within a band of about $0^m.06$ for each light curve indicating small seasonal variations.

In this short communication we report the strong light and color variations of AW UMa during the 1989 and 1990 observing seasons. We observed the system with UBV filters on five nights (20th and 21st February, 17th, 18th and 20th March) in 1989 and ten nights (7th, 8th, 11th, 12th, 13th, 14th January, 7th February, 6th, 8th and 12th March) in 1990. Differential observations with respect to the same comparison star BD +31°2270 as used by Srivastava and Padalia (1986) were secured by using an EMI 9789 QB photomultiplier attached to the 30 cm Maksutov

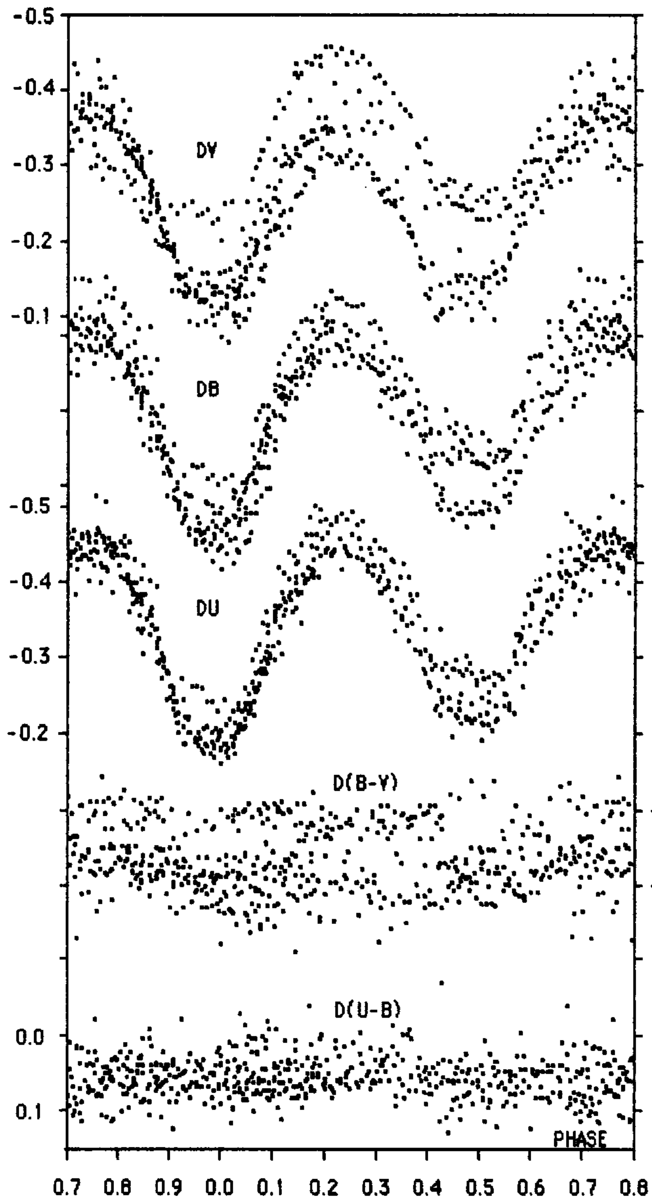


Figure 1. The light and color curves of AW UMa

telescope of Ankara University Observatory. Differential brightness measurements of the comparison with respect to the check star (BD +33°2123) in the sense that check minus comparison were found to be sensibly constant during the observations: $\Delta V = -0^m.025 \pm 0.030$, $\Delta B = -0^m.005 \pm 0.023$, and $\Delta U = -0^m.053 \pm 0.025$. The individual magnitude determinations were corrected for differential atmospheric extinction. The differential magnitudes ΔU, ΔB and ΔV, and differential color indices $\Delta(U-B)$ and $\Delta(B-V)$ in the sense variable minus comparison are plotted against phase in Figure 1.

Unusually strong light and color variations as large as $0^m.15$ in a few days time interval are displayed in Figure 1. The level and phase of maxima and minima, and thus depth of minima, all change irregularly in short time intervals. More important all such changes are seen stronger in longer wavelengths. The (B-V) index varies also more than twice in comparison to the variation of (U-B) index. A small asymmetry and small light curve and color instabilities as large as $0^m.04$ had been reported before (e. g. Hrivnak 1982, and Srivastava, Padalia 1986). No significant color variation has been noticed in the earlier observations by Paczynski (1964), Kalish (1965), Eggen (1967), Dworak and Kurpinska (1975). The large irregular variations we observed in short time intervals can not be explained only by the spot activity. We think the system entered an active phase of mass transfer in recent years, and such activity which is better seen in longer wavelengths increases in time.

It will be of great importance to obtain more systematic photoelectric observations of AW UMa, particularly in longer wavelengths to study the mass transfer activity in contact binaries.

ETHEM DERMAN
OSMAN DEMIRCAN
ZEKERİYA MÜYESSEROĞLU

Ankara University Observatory
Science Faculty, Tandoğan
06100 Ankara / Turkey

REFERENCES

Dworak, T. Z., Kurpinska, M. :1975, Acta Astronomica, **25**, 417.
Eggen, O. J. :1967, Mem. Roy. Astr. Soc., **70**, 111.
Ferland, G. J., Mc Millan, R. S. :1976, IBVS, No : **1176**.
Hrivnak, B. J. :1982, Astrophys. J., **260**, 744.

In't Zand, J. J. M., Heintze, J. R. W., Van't Veer, F. :1990, Astron. Astrophys., in press.
Kalish, M. S.:1965, Publ. Astron. Soc. of Pacific, **77**, 36.
Liu, Q., et al.:1990, Astron. Astrophys. Sinica, **10**, 42.
Mochnacki, S. W. , Doughty, N. A.:1972, Mon. Notices, **156**, 51.
Paczynski, B.:1964, Astron. J., **69**, 124.
Rensing, M. J. , Mochnacki, S. W. , Bolton, C. T.: 1985, Astron. J., **70**, 767.
Srivastava, R. K., et al.: 1989, Astrophys. and Space Sci., **154**, 179.
Srivastava, R. K., Padalia, T. D. : 1986, Astrophys. and Space Sci., **120**, 121.
Woodward, E. J., Koch, R. H., Eisenhardt, P. R.: 1980, Astron. J., **85**, 50.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3541

Konkoly Observatory
Budapest
13 November 1990
HU ISSN 0374 - 0676

1990 Optical Elliptical Polarimetry and Centimeter Flux Observations of the Very Active Solar-Type Star HD 129333

A. Elliptical Polarimetry

The infant solar-type star HD 129333 has received considerable attention recently because it exhibits the highest level of chromospheric activity known for single G-type stars. An extensive account of this star has been given by Dorren and Guinan (1990).

Because of the extreme activity of HD 129333, it was placed on the Flower and Cook Observatory (University of Pennsylvania) elliptical polarimetry observing program in 1988. A complete description of the polarimeter and observational technique is presented in Elias (1990) and Elias and Dorren (1990).

A summary of the results from the 1988 and 1989 seasons (Elias and Dorren 1990) follows. Most of the observations were performed in blue light, although a few were performed in green light. The normalized Stokes parameters q, u, and v were all variable. The average linear polarization $\overline{p}_L$ ($p_L = \sqrt{q^2 + u^2}$) was $0.12\% \pm 0.02\%$ and did not deviate significantly from this value. Most of the circular polarization (v) measures were not statistically significant, but there were two highly significant measures close to -1%. After periodogram analysis, the linear polarization parameters q and u and the position angle $\theta = \frac{1}{2} tan^{-1} \frac{u}{q}$ exhibited periods close to 14 days; 13.95 days was deemed to be the best value. A plot of θ versus phase is shown in Figure 1.

Elias and Dorren (1990) have concluded that this 14-day variation is intrinsic to the star and not produced by the environment or the instrument. Differential saturation due to the Zeeman effect (Leroy 1962) is not considered likely as the mechanism for this variation because 1) the rotational period of the star is about 2.7 days (Dorren and Guinan 1990) and 2) the amount of linear polarization is an order-of-magnitude larger than predicted and observed for this effect by Leroy and LeBorgne (1989). A better mechanism for the observed linear polarization is scattering (Thomson, Rayleigh, or Mie) from a circumstellar envelope, with the 14-day period possibly resulting from the orbital motion of an unseen companion.

Additional HD 129333 elliptical polarimetry was obtained during the 1990 season; the results are listed in Table 1. The blue θ measures (180 degrees have been added or subtracted when necessary) have been incorporated into the Figure 1 phase plot. Although it is not possible to confirm the existence of the 14-day period observed during the 1989 season, the data from the 1990 season are not inconsistent with the ephemeris HJD 2447628.802 + 13.95E from Elias and Dorren (1990). Further observations are necessary in order to investigate the possible binary nature of this star.

Linear polarization spectra were obtained on HJD 2447930, 2448043, and 2448105 (see Table 1). Within errors, it appears that the spectra are flat, implying Thomson scattering, although Rayleigh and Mie scattering cannot be ruled out. It is possible, however, to rule out magnetic effects because the ultraviolet linear polarization is not significantly larger than the blue linear polarization.

B. Centimeter Flux Observations

The cm observations of HD 129333 were performed using the NRAO* Very Large Array (VLA) in the A/B hybrid configuration on 1990 June 27. The observations were performed at 20, 6, 3.6 and 2 cm, each with two pairs of intermediate frequency stages (IFs; these included both right- and left- handed circular polarization). The IF bandwidths were 50 MHz except for the 20 cm IFs which had a bandwidth of 25 MHz. The primary calibrator was 3C286, and the secondary calibrators (B1950.0) were 1437+624 (20 cm) and 1435+638 (6, 3.6, and 2 cm). The visibilities were edited and calibrated at the VLA Array Operations Center (AOC) using natural weighting to maximize signal-to-noise.

HD 129333 was not detected at any wavelength. The 3σ upper limits to the specific flux are as follows ($1\ Jy = 10^{-26}\ W\ m^{-2}\ Hz^{-1}$): 20 cm, 183 μJy; 6 cm, 81 μJy; 3.6 cm, 57 μJy; and 2 cm, 243 μJy. These values correspond to a specific luminosity of order $10^{14}\ erg\ s^{-1}\ Hz^{-1}$ at a distance of 30 pc. These results are surprising because comparison with other chromospherically-active stars suggested estimates of the specific fluxes between 0.1 and 1.0 mJy.

---

* The National Astronomy Observatory is operated by Associated Universities, Inc., under cooperative agreement with the National Science Foundation.

Table 1

HD 129333 Elliptical Polarimetry – 1990

Filter	HJD	p_L (%)	θ (°)	v (%)
Red				
	2447930.907	0.05(0.03)	155(14)	−0.01(0.06)
	2448043.674	0.05(0.05)	4(24)	−0.01(0.06)
	2448105.679	0.01(0.06)	21(90)	+0.03(0.08)
Green				
	2447930.884	0.10(0.04)	22(12)	+0.10(0.09)
	2448043.651	0.05(0.09)	119(49)	−0.01(0.02)
	2448105.657	0.09(0.03)	79(11)	−0.12(0.08)
Blue				
	2447930.862	0.08(0.08)	155(28)	−0.09(0.11)
	2447940.760	0.10(0.06)	76(17)	+0.14(0.09)
	2447948.707	0.09(0.05)	8(14)	−0.14(0.09)
	2447949.763	0.16(0.08)	19(14)	+0.15(0.09)
	2448043.593	0.11(0.06)	179(15)	+0.19(0.13)
	2448105.634	0.06(0.06)	36(31)	+0.03(0.10)
Ultraviolet				
	2447930.840	0.13(0.15)	49(31)	+0.15(0.18)
	2447949.794	0.24(0.15)	174(19)	+0.02(0.29)
	2448043.627	0.06(0.16)	94(82)	−0.14(0.32)
	2448105.611	0.13(0.14)	153(32)	+0.03(0.17)

Note: Parenthesized quantities are 1σ errors.

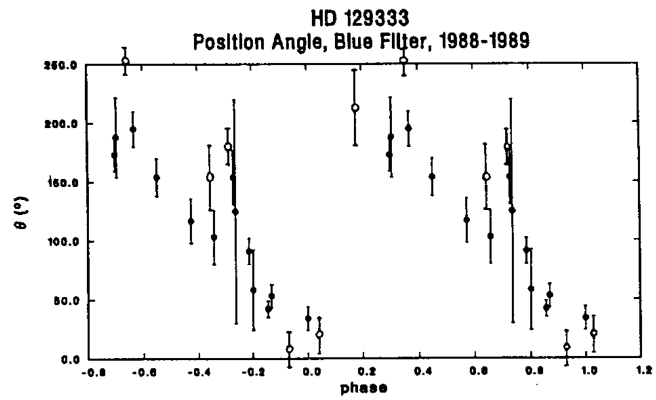


Figure 1 The filled-in circles are from the 1988 to 1989 season and the open circles are from the 1990 season. The values from the 1990 season may differ by $\pm$ 180° from Table 1.

Dr. Nicholas M. Elias II
United States Naval Observatory
34th St. and Massachusetts Ave., NW
Code AD5, Building 52
Washington, DC 20392-5100

Dr. J. David Dorren
Department of Astronomy and Astrophysics
David Rittenhouse Laboratory, E1
University of Pennsylvania
Philadelphia, PA 19104-6394

References:

Dorren, J. D. and Guinan, E. F. 1990, to be published in *Ap. J.*

Elias, N. M. 1990, *Ph.D. thesis, University of Pennsylvania.*

Elias, N. M. and Dorren, J. D., 1990, *A. J.*, **100**, 818.

Leroy, J-L. 1962, *Annales d'Astrophys.*, **25**, 127.

Leroy, J-L. and LeBorgne, J. F. 1989, *Astron. Astrophys.*, **223**, 336.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3542

Konkoly Observatory
Budapest
16 November 1990
HU ISSN 0374 - 0676

HD20629: an X-ray selected optically variable Ap star (*)

HD20629 (=SAO93386=BD+18°459=GC 3971) is a suspected chemically peculiar (CP) star (Renson *et al.*, 1990), that has been identified as the optical counterpart of the serendipitous X-ray source EXO 031656+1853.4. It has been observed during a program of systematic photometric and spectroscopic studies of stars discovered in EXOSAT X-ray images (Giommi *et al.*, 1988; Cutispoto *et al.*, 1990).

Single dwarf stars in the range B7-A5 are probably not X-ray emitters at levels greater than 10^{27} *erg/s* (Rosner *et al.*, 1985) with the exception of some CP stars (Cash and Snow, 1982). Considering a value for the interstellar reddening A_v between 0 and 2 magnitudes, we obtain a distance for HD20629 ranging from about 240 to 100 pc, respectively. Assuming an optically thin line and continuum model for a solar abundance plasma in collisional equilibrium (Mewe *et al.*, 1985) the X-ray luminosity of HD20629 is in the range $10^{29.9} \div 10^{31.5}$ $erg\ s^{-1}$, according to the assumed values for distance and absorption. These values are very high, suggesting either that the CP star is a real strong X-ray emitter or that the emission comes from a chromosperically active late-type companion.

Here we present the first results of spectroscopic and photometric observations obtained at the European Southern Observatory (La Silla, Chile).

Moderate resolution spectra both in the Hα and Ca II H and K regions have been obtained at the 1.52m ESO telescope. High resolution spectra of the Ca II H and Li I (6707 Å) lines have been obtained at the CES fed by the 1.4m CAT telescope. Several metal lines are present in these spectra. For instance in the region 4000-4300 Å the Sr II (4078 Å), Si II (4128-31 Å), Fe II

(*) based on data collected with the ESA X-ray Observatory EXOSAT and at the European Southern Observatory, La Silla, Chile.

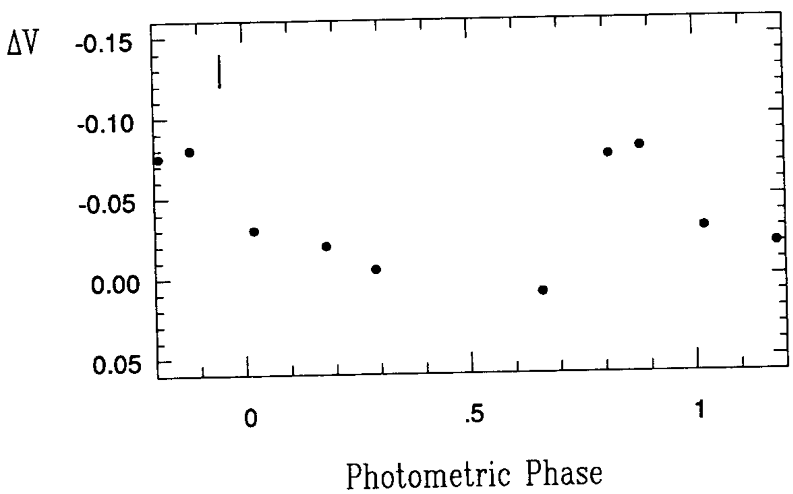


Figure 1) V light curve of HD20629. Phases are computed with the ephemeris HJD = 2448165.0 + 4.7 x E. The vertical bar shows the expected maximum error. Observations are in the instrumental system.

+ Ti II (4172-3, 4179 Å), Si II (4198 Å), Cr II (4207 Å), Cr II + Fe II (4233 + 4253 Å) lines are clearly detected, and the most appropriate spectral classification of HD20629 seems to be A0SiSrCr. No evidence for duplicity has been found.

Photometry has been obtained over the period 30 September - 11 October 1990 using the 1.0m ESO telescope feeding a single-channel photon-counting photometer equipped with a thermoelectrically cooled RCA 31034 GaAs photomultiplier tube. HD20512 and HD20278 where chosen as comparison and check star, respectively, and did not show variability. The instrumental differential V light curve, in the sense HD20629 minus HD20512 corrected for atmospheric extinction, is shown in Figure 1. HD20629 is clearly variable, with a period of 4.7 days. This value, that has to be considered as preliminary, is well in agreement with HD20629 being a CP of the SiSrCr subgroup (Catalano *et al.*, 1990). The amplitude of the V variability, about 0.09 magnitudes, is also outstanding.

Further photometric and spectroscopic observations are planned in the near future in order to obtain a more complete study of this interesting object.

G. CUTISPOTO [(1)], G. TAGLIAFERRI [(2)], F.A. CATALANO [(3)]

(1) Osservatorio Astrofisico di Catania, v.le A.Doria, 6 I-95125 Catania, Italy
(2) EXOSAT Observatory, SSD-ESTEC, Keplerlaan 1, 2200 AG, Noordwijk, The Netherlands
(3) Istituto di Astronomia, Universitá di Catania, v.le A. Doria, 6 I-95125 Catania, Italy

REFERENCES

Cash, W., Snow, T.P.: 1982, Astrophys.J. **263**, L59

Catalano, F.A., Renson, P., Leone, F.: 1990, *in progress*

Cutispoto, G., Tagliaferri, G., Giommi, P., Gouiffers, C., Pallavicini, R., Pasquini, L., Rodonó, M.: 1990, Astron. Astrophys.Suppl.Ser. in press

Giommi, P., Tagliaferri, G., Angelini, L.: 1988, in *"X-ray Astronomy with EXOSAT"*, R.Pallavicini and N.E.White (eds), Mem.Soc.Astron.Ital. **59**, 33

Mewe, R., Groneschild, E.H., van den Oort, G.H.: 1985, Astron. Astrophys.Suppl.Ser., **62**, 197

Renson, P., Gerbaldi, M., Catalano, F.A.: 1990, Astron. Astrophys.Suppl.Ser., submitted

Rosner, R., Golub, L., Vaiana, G.S.: 1985, Ann.Rev.Astron. Astrophys. **23**, 413

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3543

Konkoly Observatory
Budapest
21 November 1990
HU ISSN 0374 - 0676

THE DISCOVERIES OF V154 IN M 3

In March 1899 E. E. Barnard discovered one of the brighter stars very near the center of the globular cluster M 3 to be variable, and eventually he published (Barnard 1906) a chart and visual light curve with a period of 15.8 days for it. The star is listed as variable No. 154 in this cluster by Sawyer (1939).

This object was considered by Barnard to be new since it was not contained in Bailey's (1902) extensive list of variables in M 3, and it has generally been termed Barnard's variable (Greenstein 1935 and Joy 1940, 1949).

It is an interesting fact, however, that this star had already been discovered to be variable by E. C. Pickering almost ten years before Barnard's discovery, from four plates taken by the Harvard expedition to Mount Wilson in the summer of 1889, though the announcement (Pickering 1889) did not provide either a chart or light curve. The variability of this important object, which is the first pulsating variable to be discovered in any globular cluster, was thus a Harvard discovery, though its nature was first recognized at Yerkes.

WILLIAM P. BIDELMAN

Warner and Swasey Observatory
Case Western Reserve University
Cleveland, OH 44106

References:

Bailey, S. I. 1902, *Harvard Ann.*, **38**, 238.
Barnard, E. E. 1906, *Astr. Nach.*, **172**, 345.
Greenstein, J. L. 1935, *Harvard Bull.*, **901**, 11.
Joy, A. H. 1940, *Ap. J.*, **92**, 396.
------------ 1949, *Ap. J.*, **110**, 105.
Pickering, E. C. 1889, *Astr. Nach.*, **123**, 207. Also see *Harvard Ann.*, **38**, 1, 1902.
Sawyer, H. B. 1939, *Publ. David Dunlap Obs.*, **1**, 150.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3544

Konkoly Observatory
Budapest
21 November 1990
HU ISSN 0374 - 0676

BV LIGHT CURVES AND THE FIRST EPHEMERIS FOR THE ECLIPSING BINARY STAR NSV 1776

NSV 1776 (CSV 464) was discovered by Shapley in 1938 on photographic plates taken at the Harvard Observatory. The coordinates for the 2000.0 epoch are:

$$\alpha = 4^h56^m06^s \quad ; \quad \delta = +10^o \ 05'.9$$

The New Catalogue of Suspected Variable Stars (Kukarkin et al., 1982) classifies that star as a possible eclipsing binary, with a magnitude range 12.6 - 13.5 (p); the period is unknown.

From 925 visual estimates performed by 9 observers of the GEOS since 1987, 20 minima have been obtained, confirming the eclipsing binary nature of NSV 1776.

To improve the period and obtain BV light curves, photoelectric measurements were made at the Jungfraujoch Observatory, by M. Dumont and R. Boninsegna. The measurements were performed with a photometer attached to a 76 cm telescope. B and V filter values of the Geneva system, and the B-V values have been converted into Johnson and Morgan's system.

102 photoelectric measurements were obtained in each colour on 12 nights between 1987 and 1989. Two minima were determined with a difference in amplitude close to 0.15 magnitude in V-light. The discrimination of both minima being possible, the period can be derived from the 20 visual and the 2 photoelectric minima, weighting the last two by 3.

A first ephemeris has been computed using these 22 times of minimum light:

$$\text{Min I} = \text{hel. J.D. } 2\,447\,888.512 \pm 4 \; + \; 1^d.102\,45 \pm 2 \; * E \qquad (1)$$

(95% level of confidence for error bars)

Figure 1 shows V and B-V light curves of NSV 1776, according to the ephemeris (1). Table I lists the 22 minima (vis = visual, ph = photoelectric) and the O-C's referring to the ephemeris above. One can see the good agreement between visual and photoelectric observations. The mean B-V value,

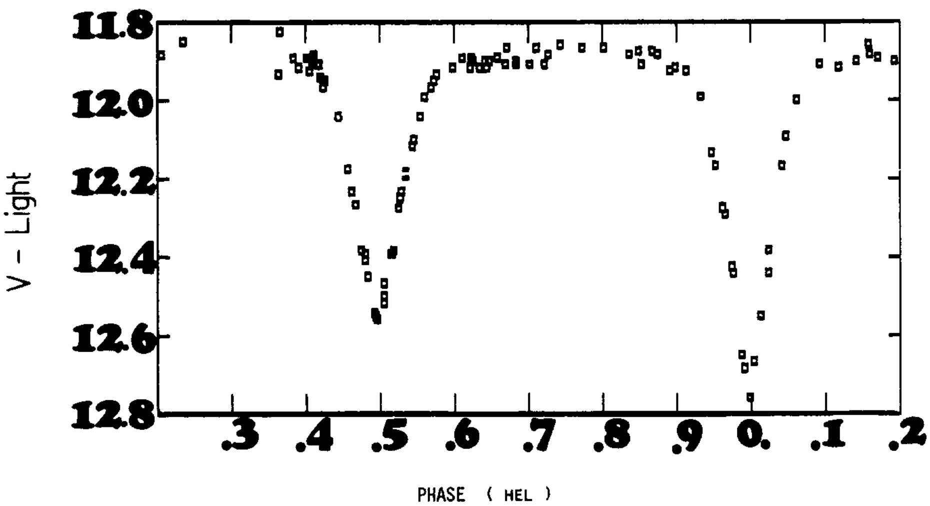


FIG 1A : V LIGHT-CURVE OF NSV 1776, ACCORDING TO THE EPHEMERIS (1).

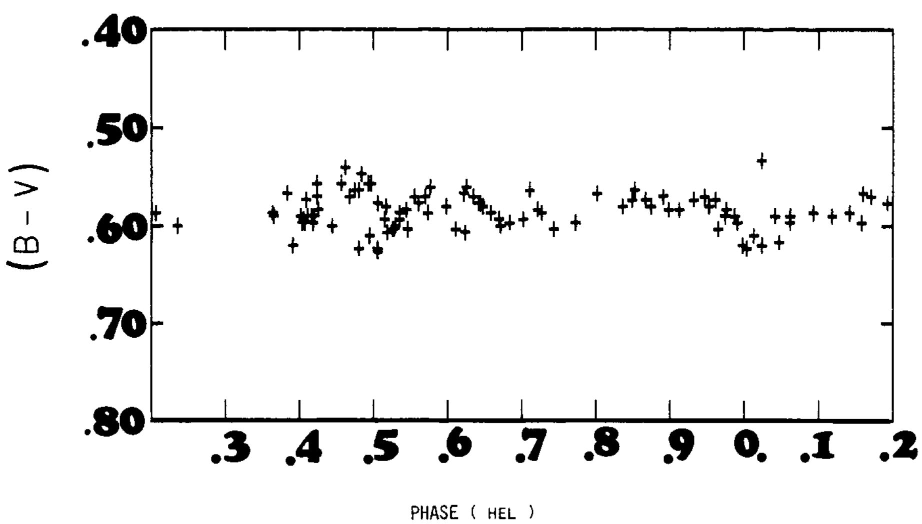


FIG 1B : B-V LIGHT-CURVE OF NSV 1776, ACCORDING TO THE EPHEMERIS (1).

TABLE I

Times of Minimum Light, According To The Following Ephemeris :

$$\text{MIN (Hel)} = 24\,47\,888.512 + 1.102\,45 * E \quad (1)$$
$$\pm 4 \qquad \pm 2$$

JD HEL. 2400000 + ...	Cycles	Type	O-C (1)	Obs.
47469.592	-380	I	+0.012	vis
47479.509	-371	I	+0.007	vis
47480.593	-370	I	-0.012	vis
47502.643	-350	I	-0.011	vis
47533.509	-322	I	-0.014	vis
47542.339	-314	I	-0.003	vis
47553.369	-304	I	+0.002	vis
47558.328	-299.5	II	+0.0004	vis
47558.338	-299.5	II	+0.01	vis
47565.494	-293	I	+0.0004	vis
47568.249	-290.5	II	-0.001	vis
47596.356	-265	I	-0.006	vis
47596.365	-265	I	+0.003	vis
47596.377	-265	I	+0.015	vis
47885.444	-30	I	+0.006	vis
47887.408	-1	I	-0.001	vis
47888.5056	0	I	-0.006	ph.
47888.512	0	I	+0.0004	vis
47891.279	+2.5	II	+0.011	vis
47892.3646	+3.5	II	-0.006	ph.
47908.366	+18	I	+0.01	vis
47945.293	+51.5	II	+0.005	vis

not corrected for reddening is 0.58.

With its typical V-light curve and the quasi-constant B-V index, which does not vary during the eclipses, NSV 1776 can be catalogued as a new EA-type eclipsing binary variable, with the following elements:

magnitude range: 11.88 - 12.76 in V light

(min II: 12.59 V)

Duration of the eclipses: $D_I = 0.20$ P

$d_{II} = 0.18$ P

G. BOISTEL[1] R. BONINSEGNA[1] M. DUMONT[1,2]

1 GEOS
3, Promenade Venezia
F-78000 Versailles

2 Palais de la Decouverte
Av Franklin D. Roosevelt
F-75008 Paris

References:

Kukarkin, B.V., Kholopov, P.N.: 1982, New Catalogue of Suspected Variable Stars (Moscow "Nauka").

Shapley, H., Hanley, C.M.: 1938, Harvard Bulletin 913, p.9

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3545

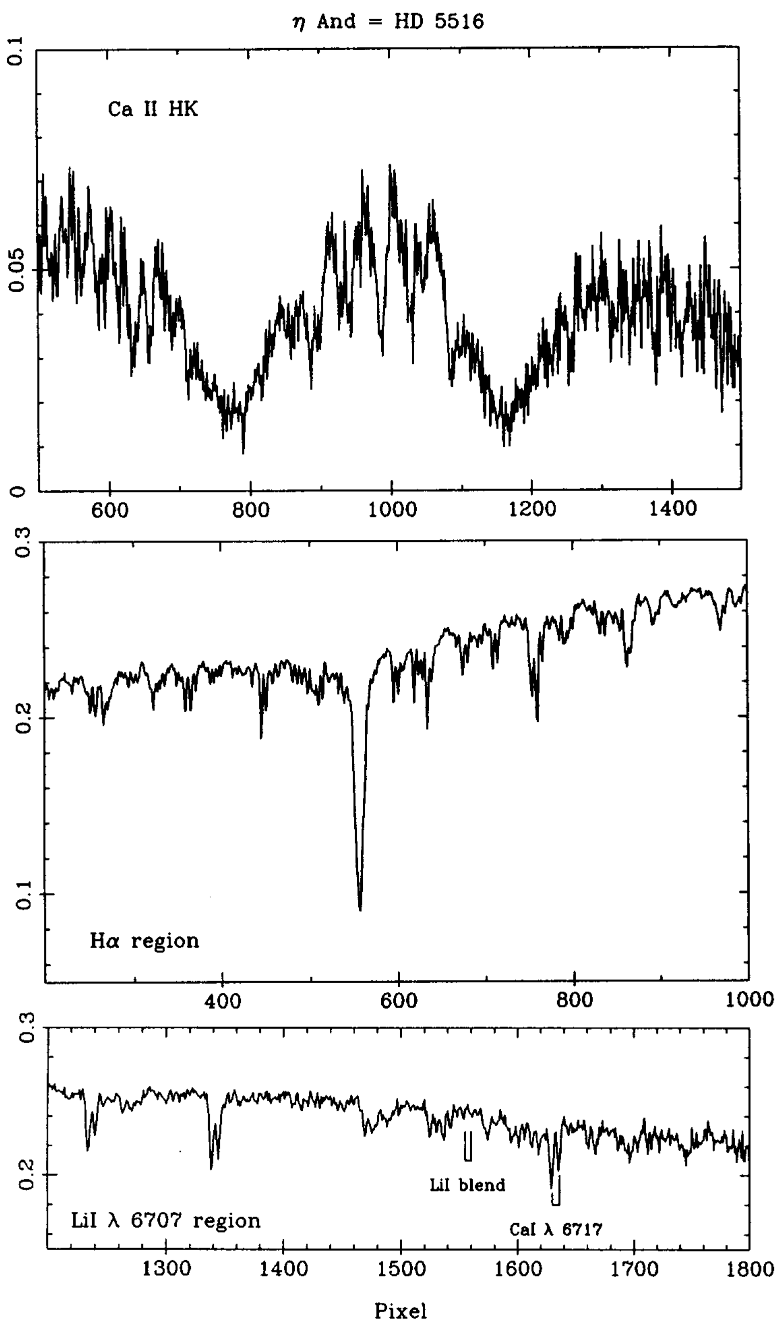
Konkoly Observatory
Budapest
28 November 1990
HU ISSN 0374 - 0676

NO "CHROMOSPHERIC ACTIVITY" SEEN IN η And

The double-lined spectroscopic binary η And (HD 5516) is listed as star # 9 in the *Catalog of Chromospherically Active Binary Stars* (CABS; Strassmeier *et al.* 1988) as having weak Ca II H and K emission lines according to Wilson's intensity class 3 (Wilson 1976). Because of the overexposure of Wilson's plates in order to bring out even very weak emission and the fact that only one 10 Å/mm plate was used, his intensity class $I_K=3$ might be an upper limit for the K-line strength. As demonstrated in the CABS catalog, if one uses high-resolution spectra to detect H and K emission, the resulting intensity class is generally higher than that of Wilson by one subclass. In this paper we report a *nondetection* of H and K emission in η And from high-resolution Echelle-Reticon spectra. Hα appears as a normal (double) absorption feature. We thus reject this star from the CABS catalog as being not chromospherically active.

The observations were obtained at the Leopold-Figl Observatorium für Astrophysik (FOA) of the University of Vienna with the 1.5m telescope in October 1990. The Echelle spectrograph (Weiss *et al.* 1981) was used in 57th order (λ_c=3938 Å) and in 34th order (λ_c=6602 Å) at dispersions of 0.08 Å/px and 0.15 Å/px, respectively. The observations utilized a 1872-pixel Reticon array (Weiss, Schalk, Ogris 1987) and had an effective wavelength resolution of 0.2 Å in the blue and 0.3 Å in the red region. The blue spectra have S/N ratios of around 30:1 and the red spectra approximately 100:1.

Fig. 1 shows parts of our spectra centered at, from top to bottom, Ca II H and K, Hα, and LiI λ6707 Å. No obvious H and K emission is present and attempts to measure an absolute emission line flux by identifying the H_1 and K_1 points failed. The lower panel in Fig. 1 shows the 6700 Å region where the position of the Lithium blends is indicated. No obvious LiI absorption is present. The Hα line in the second panel is a composite from both components but the narrower photospheric lines appear clearly doubled. From these we derive $v \sin i$ for both components of 5 ± 2 km s^{-1}. These values supersede the <15 km s^{-1} values of Herbig and Spalding (1955) which were derived from blue spectra ($\lambda_c \sim$4500 Å) where blending is much more severe.



η And = HD 5516
Ca II HK
0.1
0.05
0
600
800
1000
1200
1400
0.3
0.2
0.1
Hα region
400
600
800
1000
0.3
0.2
LiI blend
CaI λ 6717
LiI λ 6707 region
1300
1400
1500
1600
1700
1800
Pixel

Figure 1

Gordon (1946) found the component with the larger radial-velocity amplitude being also the fainter but assigned identical spectral classifications (G8 III-IV). Petrie (1950) measured a brightness difference between the two components of 0.29±0.02 mag from 6 FeI and TiII lines at around 4500 Å. From our red-wavelength spectrum centered at 6600 Å we find a mean ratio of the line strengths of 0.78±0.08 from eight FeI and CaI lines corresponding to a magnitude difference of 0.27±0.08 mag in the same sense than found by Petrie. With equal brightness differences in the red *and* in the blue, the brighter component must be of (approximately) equal spectral type but slightly larger, and thus slightly more massive which is in agreement with the observed mass ratio of 1.11. If we assume synchronous rotation (i.e., $P_{rot} = P_{orb}$), our $v \sin i$ measures translate into minimum radii of 11±5 $R_{\odot}$. Thus, the giant classification seems to be appropriate for both components.

Two ultra-violet spectra are available in the IUE archive. SWP26529 was underexposed and shows mostly noise. CIV was not detected to an upper limit of about 5×10^{-13} ergs.cm^2.s^{-1} (J. Eaton, private communication). LWP4671 shows double, but otherwise normal, Mg II h and k lines (Fig. 2).

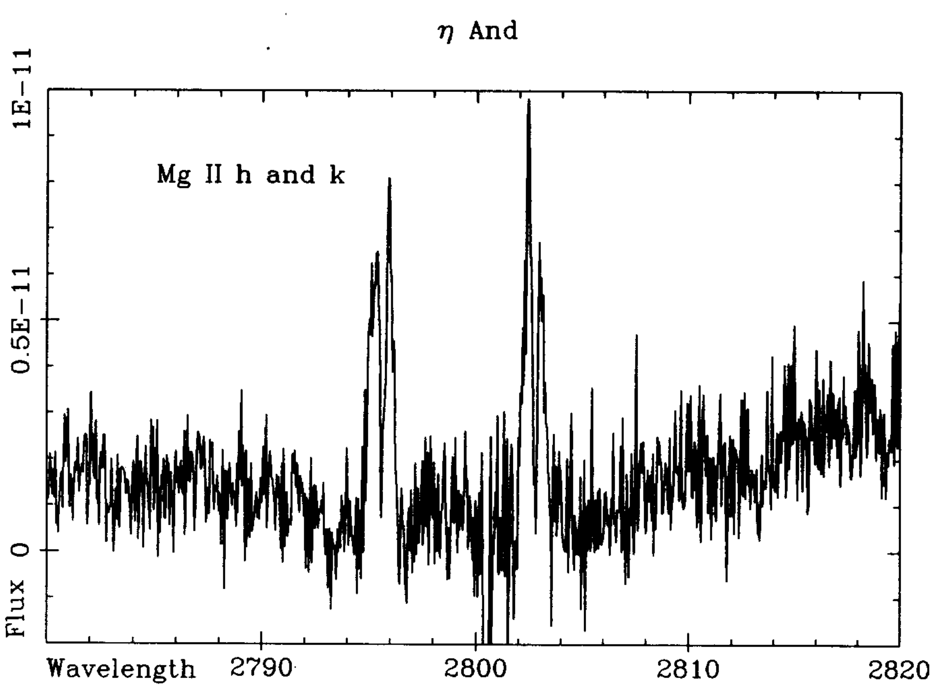


Figure 2

With an orbital period of 115 days, e≡0 (Batten, Fletcher, MacCarthy 1989) and assumed synchronism, η And would be already an unlikely case of an active binary system of the long-period RS CVn class. Another long-period system (4 UMi, P_{orb}=605 days) originally listed in the CABS catalog as having weak (I_K=3) H and K emission, was recently found to be chromospherically inactive (Strassmeier *et al.* 1990). There are two more systems in the catalog which need high-resolution Ca II H and K observations to verify (or contradict) Wilson's eye-based estimates: ν^2 Sgr and τ Sgr.

K. G. STRASSMEIER
J. HRON
Institut für Astronomie
Universität Wien
Türkenschanzstraße 17
A-1180 Wien
AUSTRIA

References

Batten, A. H., Fletcher, J. M., MacCarthy, D. G. 1989, EIGHT CATALOG OF THE ORBITAL ELEMENTS OF SPECTROSCOPIC BINARIES, *Publ. Dom. Astrophys. Obs.*, **17**, 1.

Gordon, K. C. 1946, *Ap. J.*, **103**, 13.

Herbig, G. H., Spalding, J. F. Jr. 1955, *Ap. J.*, **121**, 118.

Petrie, 1950, *Pub. Dom. Astrophys. Obs.*, **8**, 319.

Strassmeier, K. G., Hall, D. S., Zeilik, M., Nelson, E., Eker, Z., Fekel, F. C. 1988, *Astr. Ap. Suppl.*, **72**, 291.

Strassmeier, K. G., Fekel, F. C., Bopp, B. W., Dempsey, R. C., Henry, G. W. 1990, *Ap. J. Suppl.*, **72**, 191.

Weiss, W. W., Barylak, M., Hron, J., Schmiedmayer, J. 1981, *Pub. A. S. P.*, **93**, 787.

Weiss, W. W., Schalk, A., Ogris, V. 1987, *Pub. A. S. P.*, **99**, 303.

Wilson, O. C. 1976, *Ap. J.*, **205**, 823.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3546

Konkoly Observatory
Budapest
5 December 1990
HU ISSN 0374 - 0676

"NOVA" PQ And - FURTHER OUTBURSTS

PQ And was discovered by McAdam (1988) on photographs taken on 1988 March 21. Further observations by several authors (IAU Circ. Nos. 4570, 4577, 4579, 4620, 4628 and 4629) show a novalike decline from $10^{m}.0$ (March 21) to $18^{m}.8$ (July 9), see Fig. 1. Spectral data are very poor: According to Wade (1988) the post eruption spectrum resembles WZ Sge.

Therefore and because Hurst (1988a) suspected a second eruption in 1976 Oct. 19 (which, however, he revised soon after, 1988b), the object was examined on 1725 Sonneberg plates taken between 1928 and 1989. The plate limit is mostly between 13^{m} and 14^{m}. The magnitudes were determined by linking the comparison stars (Fig. 2) to the photoelectric sequence by Johnson (1954) of the nearby cluster M34:

star	B
r	10.87
a	11.50
b	13.00
c	14.05
d	14.50

Neither the 1988 eruption nor that particular 1976 eruption could be checked, for lack of plates; but it turned out that additional outbursts took place in 1938 and 1967 (see Table I). Of course, these data are too poor to get any reliable estimation of the true cycle length of eruptions by statistical methods described by Wenzel and Richter (1986). Formal application of their formula leads to the following results:

Taking the plate limit to be $14^{m}.0$ (fainter magnitudes are mostly only marginally visible and are easily overlooked), we have:

Number of plates N = 1725
Number of plates with brightenings]$14^{m}.0$ n = 6
Time interval t = 62 a
Effective time interval T = 46.5 a
Duration of outbursts ( ]$14^{m}.0$) L = 30 d

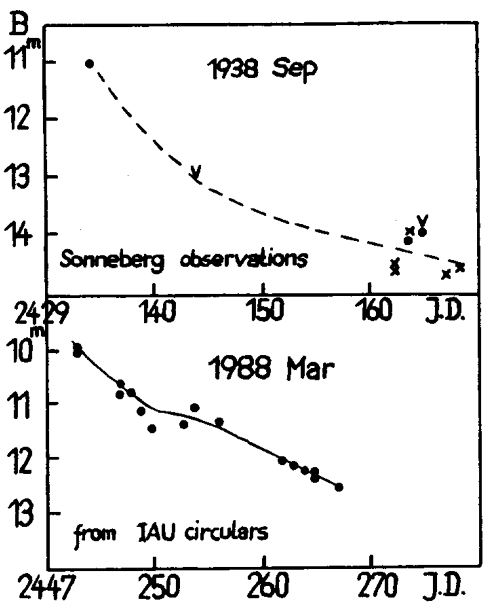


Figure 1

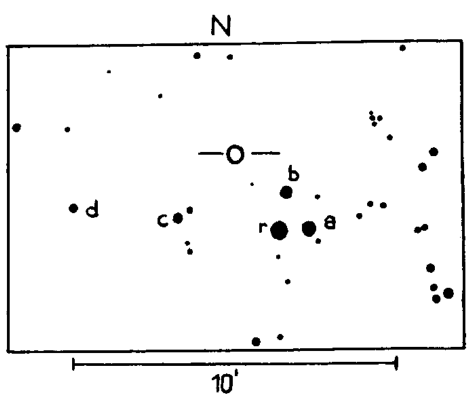


Figure 2

Poisson parameter $\lambda = 2.82$

With these data we obtain the following estimations:

$C_1 = \lambda T/n = 21.9$ a

$C_2 = LN/n = 23.6$ a

In reality, the mean cycle length C will be probably smaller, between about 10 a and 20 a.

According to the A-log C relationship of Richter (1986) the cycle length is about 12 years, if the amplitude is 8.8 mag.

Table I

date	JD 2429..	B	date	JD 2439..	B
1938 Aug. 6	117.54	[$13\overset{m}{.}5$	1967 Mar. 7	557.28	$10\overset{m}{.}8$
23	134.55	11.0	7	557.31	10.9
Sep. 2	144.46	[13	Apr. 2	583.32	[14.5
20	162.57	14.4:			
20	162.60	14.5::			
21	163.53	14.0			
21	163.55	13.9::			
23	165.53	13.9			
23	165.55	[13.9			
25	167.56	14.8::			
26	168.55	14.7::			

To sum up it can be said that PQ And, which has an amplitude of nearly 9 mag, is either a recurrent nova or a long cyclic U Geminorum star, the latter being more probable because its spectrum resembles that of WZ Sge as already mentioned.

G.A. RICHTER

Zentralinstitut für Astrophysik
Sternwarte Sonneberg
0-6400 Sonneberg
Germany

References:

Hurst, G.M.: 1988a, IAU Circ. No. 4577.
Hurst, G.M.: 1988b, IAU Circ. No. 4579.
Johnson, H.L.: 1954, Astrophys.J. 119, 185.
McAdam, D.: 1988, IAU Circ. No. 4570.
Richter, G.A.: 1986, Astron.Nachr. 307, 221.
Wade, R.A.: 1988, IAU Circ. No. 4629.
Wenzel, W., Richter, G.A.: 1986, Astron.Nachr. 307, 209.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3547

Konkoly Observatory
Budapest
5 December 1990
HU ISSN 0374 - 0676

The X-Ray Source 1E1615.0+3114 Is an Eclipsing Binary

From an examination of the Einstein Observatory Extended Medium Sensitivity Survey, Fleming et al. (1989) compiled a list of seven stars expected to be W UMa systems. In a continuing investigation of these systems we have observed six of them. We have published results on 1E1654.0+3515 (Robb 1989), 1E1806.1+6944 (Robb and Scarfe 1989), 1E2119.7+1655 (Robb 1990), HD197010 (Robb et al 1990), and reports on others are in preparation. This is a report of our observations of 1E1615.0+3114 another of the stars from the list. In the Guide Star Catalog its identifier is GSC 02580 01971 and its position is Right Ascension +16:16:54 and Declination +31:07:21 (Equinox 2000) (Jenkner et al 1990). Its brightness of 12.6 in the V band and spectral class of G0 were given by Fleming et al. (1989). A finder chart adapted from Papadopoulos et al. (1980) is given for this star in figure 1.

1E1615.0+3114 was observed using the 0.5 meter reflector of the Climenhaga Observatory at the University of Victoria on nineteen nights between 26 June 1990 and 23 September 1990. Computer control of the telescope allows us to point it at each of the stars at the beginning of the night and then leave it to follow a program of observations until the star reaches too large an airmass. Due to the similarity of the variable, comparison and check stars in both position and color, mean extinction and transformation coefficients were used to correct the differential magnitudes to the Johnson V and Cousins R system (Landolt 1983). The observations of the variable star were bracketed by observations of the comparison star SAO 065206, whose constant brightness was monitored with more than one hundred observations of the check star, GSC 02580 02402, an 11th magnitude star at Right Ascension 16:16:34 and Declination 31:10:31 (Equinox 2000). The mean check star minus comparison star magnitude was 3.962 ± 0.023 in V and 4.035 ± 0.032 in R. The errors are standard deviations about the mean, and assure the constancy of the comparison and check stars at this level. Means of each of the fifteen nights of data were calculated and the standard deviation of the nightly means was 0.015 in both bands, assuring the night to night variations are smaller than this amount.

A time of minimum brightness was found using a program based on the method of Kwee and Van Woerden (1956) and checked using the tracing paper method. Observations in each color were treated individually, but since there was no significant difference between the times obtained, they were

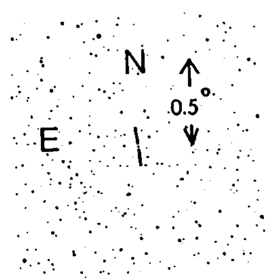
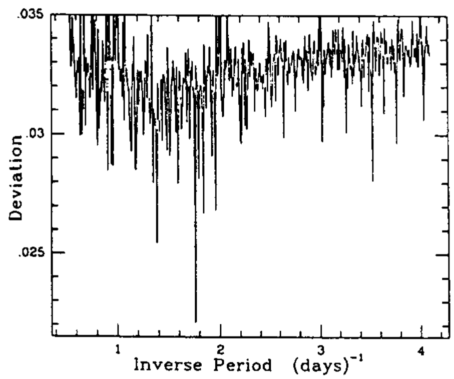


Figure 1. - Finder chart for X-Ray source, 1E1615.0+3114; centered on Right Ascension 16:16:54 and Declination +31:07:21 (2000.0).

Figure 2.



Average standard deviation of forty bins versus inverse period.

combined in a mean, weighted inversely by the error in each color's determination. The heliocentric time of minimum based on all points within 0.05 days of the minimum is 2448117.7698. Branches of eclipses were observed on four nights and times of minima could be estimated approximately. The period found from these times of minimum light was $0^d.5679 \pm 0.0001$ with residuals of about eight minutes.

Another estimate of the period was found using a method based on the Phase Dispersion Minimization method of Jurkevich(1971). Plotted in figure 2 is the average standard deviation of forty phase bins as a function of the inverse period. The deep minimum at 1.76 inverse days indicates the orbital period of the system and the shallow minima are fractions and aliases of the true period. The period given below is found from inspection of a similar plot with ninety bins and much smaller inverse period spacing. A precise estimate of the epoch is the minimum of the light curve based on all the data points folded on the period below. The ephemeris best fitting the light curve is found to be:

$$\text{Helio. J. D. of Primary Minimum} = 2448117.7714(4) + 0.56789(5)E.$$

This period is too long to be in agreement with the period-color relation of Eggen (1967) for contact binaries.

The radial velocities reported by Fleming et al (1989) plotted according to this ephemeris do not fit the sine curve expected of a close binary star. The largest and smallest velocities occur at almost the same phase and considering the orbital period imply a system mass of about ten solar masses. If they are ignored, the four remaining velocities can be fitted by a sine curve with an amplitude of 104 ± 34km/sec and a mean velocity of 21 ± 27km/sec. In this case maximum velocity precedes the predicted phase of mid primary eclipse by $0.03 \pm .07$ of the period, which is barely consistent with the hypothesis that it is the star, which produces the observed spectrum, that is eclipsed at primary minimum. The phase of the ignored points would then be that of the secondary minimum, where we would not be surprised to see the effects of rotation or gas streams. The amplitude is consistent with a mass of one solar mass for the observed star for a range of plausible mass ratios. However due to the small number of velocities and the large uncertainties in their determination, we do not feel it prudent to use them to refine our estimate of the orbital period.

Due to the relative faintness of the star, modest size of our telescope, and small integration times, the individual observations have rather large uncertainties. They have therefore been combined into the twenty-eight V and R band normal points plotted in figures 3 and 4. The error bars represent one standard deviation of the mean. This curve clearly shows the variation expected for an eclipsing

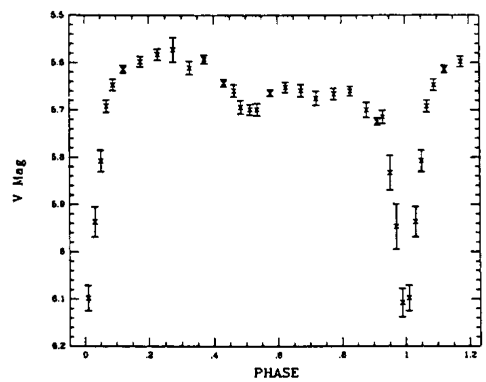


Figure 3. - V filter light curve normal points plotted with PHASE = (JULIAN DATE - 2448117.7714) / 0.56789.

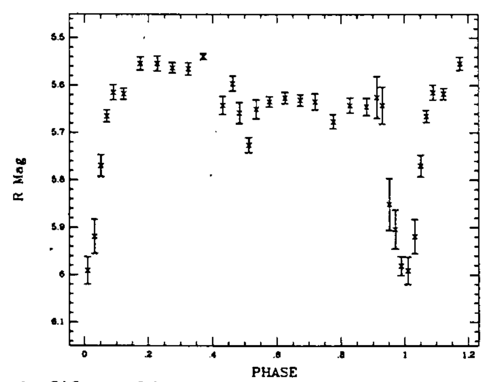


Figure 4. - R filter light curve normal points plotted with PHASE = (JULIAN DATE - 2448117.7714) / 0.56789.

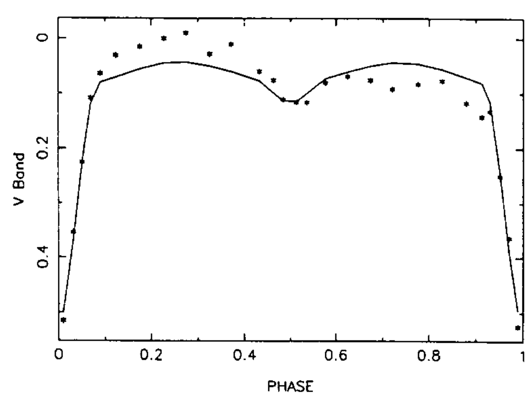


Figure 5. - V band normal points plotted with a model light curve assuming the stars temperatures are 6030 and 3900 degrees and the hot star's fractional radius is 0.25, and that of the cool star's is 0.32. Orbital parameters assumed are a mass ratio of 0.7 and an inclination of 70 degrees.

binary system. The difference in depth of the minima show that the two stars are of very different temperature and thus not in good thermal contact. The (V-R) color curve is 0.1 magnitudes redder at the primary minimum, consistent with the secondary of the system contributing little light at these wavelengths. The unusual curvature in the first maxima relative to the flatness of the second maximum was observed on a number of nights and may be a permanent feature of the light curve.

A computer modelling program written by G. Hill (1979) was used to find approximate elements of the system. From the spectral classification of G0 (Fleming et al. 1989), we assumed a temperature of 6030 degrees and convective envelope with full limb darkening. The atmospheres were assumed to be black bodies. Since we have no information as to the mass ratio of the system we have assumed a mass ratio of 0.7. As shown in figure 5 the best match was found for fractional radii of 0.25 for the hot star and 0.32 for the cool star, a temperature of the cool star of 3900 degrees and an inclination of 70 degrees. These numbers must be regarded as very preliminary values, since the the observed light curve is not of very high precision, the mass ratio is unknown and there is some asymmetry in the brightness of the maxima. However we can see that for a mass ratio less than about 0.7 the secondary star fills its Roche lobe. If the amplitude of the radial velocity curve of the primary star is assumed to be 122km/sec, consistent with the observed velocities, then the primary star has a mass, radius and luminosity consistent with its spectral classification. The secondary star would be very large and cool, but with roughly the bolometric luminosity for its mass.

The X-ray source 1E1615.0+3114 is an eclipsing binary system with a period of 0.568 days and an amplitude of 0.4 magnitudes. Spectroscopic observations of this system will be important to find accurate component masses and the mass ratio. Further photometric observations will be important to refine the orbital period, and to look for changes in the asymmetry of the maxima and to permit a more detailed solution than has been attempted here.

R. M. ROBB
F. W. DEAN
C. D. SCARFE
Climenhaga Observatory
University of Victoria
Victoria, B.C., Canada

REFERENCES

Eggen, O. J., 1967, Mem. Roy. Astr. Soc., 70, 111

Fleming, T. A., Gioia, I. M. and Maccacaro, T., 1989, Astron. J., 98, 692

Hill, G., 1979, Pub. Dom. Astr. Obs., XV, 267

Jenkner, H., Lasker, B., Sturch, C., McLean, B., Shara, M., Russell, J., 1990, Astron. J., 99, 2082

Jurkevich, I., 1971, Ap. Space Sci., 13, 154

Kwee, K. K. and Van Woerden, H., 1956, Bull. Astr. Inst. Neth., 12, 327

Landolt, A. U., 1983, Astron. J., 88, 439

Papadopoulos C. and Scovil C., 1980, The True Visual Magnitude Photographic Star Atlas (Pergamon Press, Toronto, Canada)

Robb, R. M., 1989, IBVS 3346

Robb, R. M. and Scarfe, C. D., 1989, IBVS 3370

Robb, R. M., 1990, IBVS 3430

Robb, R. M., Dean, F. W. and Scarfe, C. D., 1990, IBVS 3536

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3548

Konkoly Observatory
Budapest
6 December 1990

HU ISSN 0374 - 0676

PHOTOMETRY OF CAPELLA (Dec 1981 TO Apr 1990)

Capella (= α Aurigae = BS 1708 = Gliese 194) is part of a multiple star system, the two brightest components of which make up a spectroscopic binary composed of a G6 III and an F9 III star (Ayres and Linsky 1980). According to Fekel *et al.* (1986, on p. 570), the G6 star has a rotational rate of v sin i = 5 ± 2 km/sec, while the F9 star has v sin i = 36 ± 3 km/sec.

The orbit of the bright Capella components has been investigated by interferometric methods. Bagnuolo and Hartkopf (1989) find an orbital period of 104.02 days and an inclination of the orbit of 136.6 degrees. (If the position angle increases with time the inclination is between 0 and 90 degrees, where 0 degrees means we view the orbit face on. By convention, if the position angle decreases with time $90 < i < 180$.) Assuming that the rotational axes of the Capella components are perpendicular to the plane of their orbit, angle i for v sin i is 46.6 degrees.

Ayres, Marstad, and Linsky (1981) derive apparent angular diameters of 8.81 and 5.00 milli-arcsec for the G6 and F9 stars, respectively. Adopting a parallax of 0.0768 arcsec for Capella (Bagnuolo and Hartkopf 1989, quoting van Altena data), we obtain diameters of 11.5 and 7.0 D_{Sun} for the G6 and F9 stars. Given the observed values of v sin i and i = 46.6 degrees, we can obtain expected rotational periods for the stars. For the F9 star we obtain P_{rot} = 7.2 ± 0.6 days. For the G6 star we obtain a "best guess" value of 84 days, but the large relative error of its v sin i allows P_{rot} to be anywhere between 60 and 130 days. Given the semi-major axis orbit size of 0.05523 arcsec (Bagnuolo and Hartkopf 1989), equivalent to 155 R_{Sun}, we note that the two stars are separated by many times their diameters. (Tidal distortions of the two stars, giving rise to different projected surface areas, would result in variability of about 0.003 mag, much smaller than our observational error.)

From ultraviolet observations Ayres and Linsky (1980) indicate that the F star is chromospherically active.

Consequently, one might expect it to exhibit star spots, and as it rotates there could be measurable light variability. Hoffleit and Jaschek (1982) give $\Delta V = 0.03$ for Capella's variability, but no further details are given.

Recently, Shcherbakov *et al.* (1990) have found that the equivalent width of the He 10830 Å line of Capella varies with a period of 104 days, equal to that of the orbital period. They attribute this to the G9 star. This is to say that the *source of chromospheric helium absorption* on the G9 star faces the F6 star at all times, but it is possible that the G6 star could be rotating at a somewhat different rate.

In this paper we present photometry of Capella that can be found in IAU file 218 of unpublished photometry of variable stars (Breger *et al.* 1990). This file contains photometry of Capella vs. BS 1668 (V = 5.68, B-V = 0.42; Hoffleit and Jaschek 1982), obtained by Guinan using the Villanova 38-cm reflector and narrow-band b, y, and r filters at effective wavelengths of 4530, 5500, and 6600 Å, respectively. He also employed a neutral density filter which attenuated the b-band light of Capella by 5.262 mag, the y-band light by 5.200 mag, and the r-band light by 5.150 mag. His data are shown in Fig. 1. We note that at times Capella *is* constant: Guinan's r- and b-band data from 5 nights in Dec 1981 exhibited no variations greater than ±0.005 mag. Guinan believes that the fading by a few hundredths of a magnitude after JD 2447000, most notable in the r-band data, is real, rather than due to any instrumental effect such as the alignment of his neutral density filter.

File 218 also contains broad-band differential V magnitudes and B-V colors of Capella vs. 9 Aur and Capella vs. BS 1668. A small sample of previous photometry of Capella vs. 9 Aur (Krisciunas 1984) showed no significant variations from Feb 1980 to Mar 1981, but more recently we have found that 9 Aur exhibits variability of $\Delta V \approx 0.04$ to 0.08 with a period of 37.5 ± 2.0 days (Krisciunas and Guinan 1990) and suspected short-term periodic variability as rapid as 34 minutes. Krisciunas' photometry shown here was primarily obtained at the 2800-m elevation of Mauna Kea, Hawaii, using a 15-cm reflector and a photometer employing an uncooled RCA 931A photomultiplier tube, standard UBV filters, a DC amplifier, and a strip chart recorder. Beginning in January 1989 (JD 2447545) Krisciunas made his observations of Capella, 9 Aur, and BS 1668 using a Hartmann screen on the front of the telescope, which diminished the stars' light by

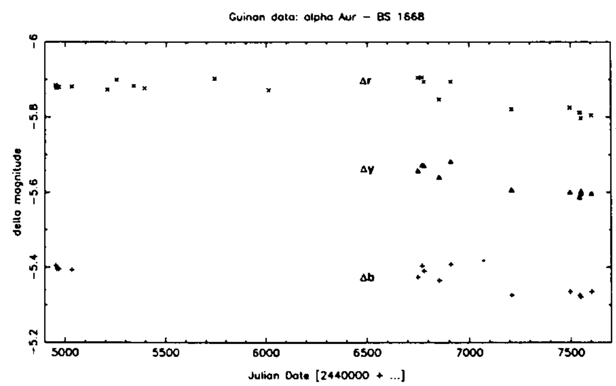


Fig. 1 - Differential magnitudes of Capella vs. BS 1668 by Guinan. X's: Δr data (6600 Å). Triangles: Δy data (5500 Å). +'s: Δb data (4530 Å).

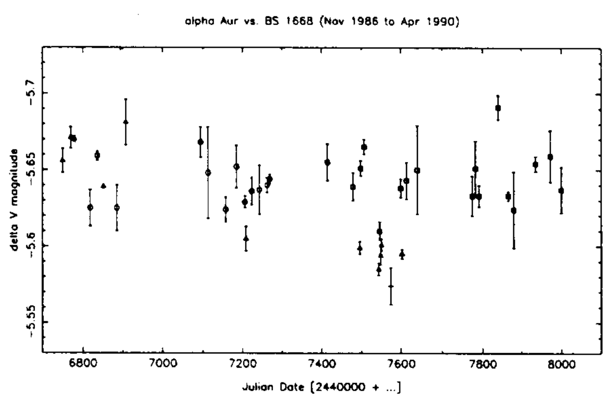


Fig. 2 - Differential photometry of Capella, primarily with respect to BS 1668.
Triangles: Δy data (5500 Å) by Guinan. Squares: ΔV data of Krisciunas, reduced from strip chart tracings. +: Krisciunas ΔV datum reduced from ammeter readings. Circles: Krisciunas ΔV data of Capella vs. 9 Aur, corrected for 39.4 day, ΔV = 0.07 variations of 9 Aur and adjusted for <ΔV> of 9 Aur vs. BS 1668.

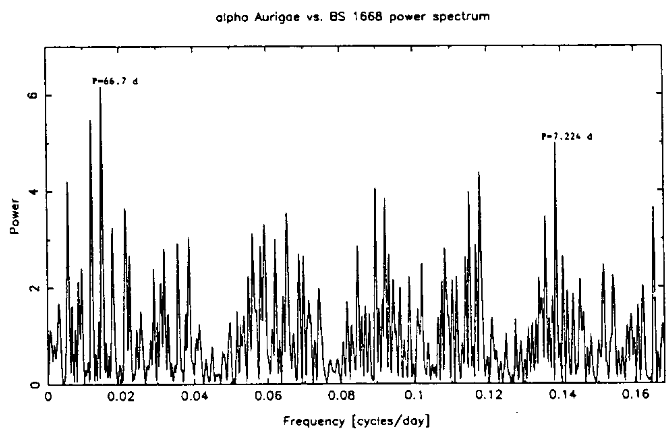


Fig. 3 - Power spectrum of data from Fig. 2, using the Lomb-Scargle algorithm. The 5 points of Guinan from JD 2447495 to 2447602, and the Krisciunas datum reduced from ammeter readings, have been eliminated from the analysis.

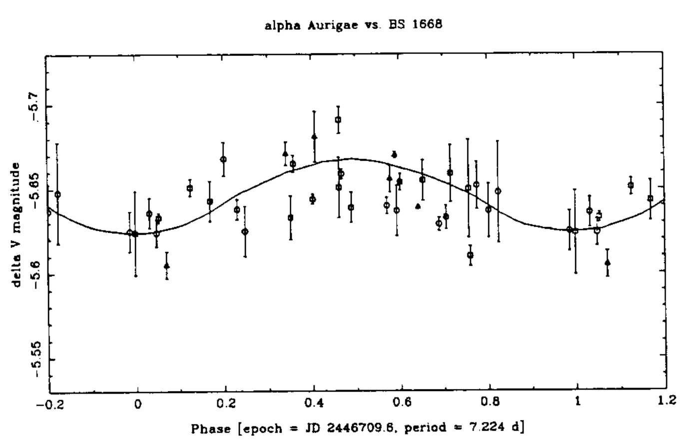


Fig. 4 - Data of Fig. 2 (excepting 5 points of Guinan from JD 2447495 to 2447602 and Krisciunas datum reduced from ammeter readings), folded with a period of 7.224 days. Epoch of minimum = JD 2446709.6.

about 1 magnitude. This was to ensure that Capella did not saturate the photomultiplier tube.

Fig. 2 shows Guinan's Δy data and Krisciunas's ΔV data for Capella vs. BS 1668. It also includes data of Capella vs. 9 Aur, obtained from Jan 1987 to Apr 1988 (JD 2446817 to 2447268), reduced to the "Capella vs. BS 1668 system" as follows: an epoch of minimum of JD 2447242.43 and period of 39.4 days was adopted for 9 Aur, with a peak to peak amplitude of ΔV = 0.07 mag. The mean ΔV = -0.708 ± 0.004 for 9 Aur vs. BS 1668, obtained from 84 measurements of 9 Aur vs. BS 1668, made from Sep 1988 to Apr 1990, was then added to obtain the equivalent "Capella vs. BS 1668" values.

We note that the Capella vs. 9 Aur photometry, along with the mean ΔV of 9 Aur vs. BS 1668 and V = 5.68 for BS 1668, gives us $\langle V \rangle$ = +0.041 for Capella from Jan 1987 to Apr 1988. This compares well with $\langle V \rangle$ = +0.039 ± 0.006 from Krisciunas' Capella vs. BS 1668 photometry of Sep 1988 to Apr 1990. Thus, Krisciunas' data show no evidence of a discontinuity of the mean brightness after JD 2447000.

We have investigated the data of Fig. 2 with the Discrete Fourier Transform algorithm of Deeming (1975, 1976), and by means of the Lomb-Scargle algorithm for unevenly spaced data (see Press and Teukolsky 1988 and references therein). The latter is to be preferred, because it is not only more adept at extracting correct periods from noisy data, but allows one to assign a "false alarm probability" to any peaks in the power spectrum (i.e. the probability that a peak is just due to random noise) even for frequencies much higher than the Nyquist frequency (the reciprocal of twice the average sampling internal). A false alarm probability of 0.01 or less is considered good evidence that a particular frequency is not due to noise.

Given the 41 points in Fig. 2, both algorithms give a peak of the power spectrum corresponding to a period of about 28.1 days, but this may hinge on a gain change inherent in Guinan's data of JD 2447495 to 2447602, which appear as the minimum if the data are folded with that period. If we eliminate those 5 points and the datum of Krisciunas reduced from ammeter readings instead of strip chart tracings, and investigate all frequencies up to 2 times the Nyquist frequency, there are peaks in the power spectrum corresponding to periods of 81.96 and 66.66 days, both comparable to the rotation rate of the G6 III star; the false alarm probabilities are 0.251 and 0.137, respectively. A peak corresponding to a period of 104 days is not found. If we investigate frequencies up to 12 times the Nyquist frequency (Fig. 3), the likelihood that the 82 and 67 day periods are spurious increases significantly (to 0.823 and 0.586), but we obtain a peak in the power spectrum at F = 0.1384 cycles/day, or a period of 7.224 days, equal to the expected rotation rate of the F9 III star.

In Fig. 4 we show the data of Fig. 2, excluding the 6 points mentioned above, folded with a period of 7.224 days. A sinusoid with peak to peak amplitude $\Delta V \approx 0.04$ is suggested, but the average sampling rate is too long, and the photometric accuracy too poor, for us to claim that such a period has been conclusively demonstrated. Also, if we are to believe the error bars, there is more happening to Capella than variability attributable solely to the rotation of the F9 III star. In any case, we now have a much better upper bound to the level of Capella's apparent variability, based on several years of measurements.

K. KRISCIUNAS
Joint Astronomy Centre
665 Komohana Street
Hilo, Hawaii 96720 USA

E. GUINAN
Villanova University
Department of Astronomy
Villanova, PA 19085 USA

References:

Ayres, T. R., and Linsky, J. L. 1980, *Ap. J.* **241**, 279.
Ayres, T. R., Marstad, N. C., and Linsky, J. L. 1981, *Ap. J.* **247**, 545.
Bagnuolo, W. G., Jr., and Hartkopf, W. I. 1989, *A. J.* **98**, 2275.
Breger, M., Jaschek, C., and Dubois, P. 1990, IBVS 3422.
Deeming, T. J. 1975, *Ap. and Space Sci.* **36**, 137.
__________ 1976, *ibid.* **42**, 257 (errata to above).
Fekel, F., Moffett, T. J., and Henry, G. W. 1986, *Ap. J. Suppl.* **60**, 551.
Gliese, W. 1969, *Veroeffentlichungen des Astron. Rechen-Inst.* No. 22.
Hoffleit, D., and Jaschek, C. 1982, *The Bright Star Catalogue*, 4th ed. (New Haven: Yale Univ. Obs).
Krisciunas, K. 1984, IBVS 2538.
Krisciunas, K., and Guinan, E. 1990, IBVS 3511.
Press, W. H., and Teukolsky, S. A. 1988, *Computers in Physics* **2**, No. 6 (Nov/Dec), 77.
Shcherbakov, A. G. *et al.* 1990, *Astron. Astrophys.* **235**, 205.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3549

Konkoly Observatory
Budapest
2 January 1991

HU ISSN 0374 - 0676

uvby OBSERVATIONS OF THE ALGOL-TYPE STAR V1156 CYGNI

In a systematical search for positional coincidences between IRAS point sources and Algol-type variables Friedemann and Löwe (1990) found that besides other canditates one component of V1156 Cygni could be surrounded by an accretion disk. It may be the source of the observed infrared excess.

Up to now, for this variable are known only photographic magnitudes. They were published by Wachmann (1966) who discovered the variability of that star.

On December 6 and 7 1990 we carried out uvby photometry of the variable star V1156 Cyg = HBV 430. The observations were collected with the 90 cm telescope of Jena University Observatory at Großschwabhausen observing station.

For technical and observational procedures as well as details of the reduction process see Reimann et al.(1989). Our measurements seem to be the first photoelectric observations of this variable, but in a non-eclipsed phase. We measured additionally the uvby magnitudes and derived colours of three comparison stars given in Table I. It contains photographic magnitudes previously obtained by other authors, too. The sets of magnitudes differ remarkably in a systematic manner from each other.

Table I. Magnitudes of comparison stars

Identification	Wachmann m_{pg}	Woroschilov et al. V	Woroschilov et al. B	present Results V	Sp.type
a	13.28	12.27	13.08		G3 III*)
b	13.67	12.84	13.37	13.16	B6 V
c	13.84	12.77	13.56		
d	14.32	13.36	13.96		
e	14.97	13.53	14.38		
f		9.82	10.21	10.05	F1 V
g		10.16	10.70	10.07	B0 V

*) spectral type according to Woroschilov et al.(1969)

For a convenient identification of the stars of interest we give a copy of the finding chart of the variable from Wachmann (1966) in Figure 1. Our two additional comparison stars are labelled by the letters f and g.

Table II. Observations of V1156 Cyg = HBV 430

Julian date	y = V	b-y	m1	c1
2448231.8692	12.715	0.679	0.118	0.801
2448232.7779	12.696	0.671	0.139	0.782

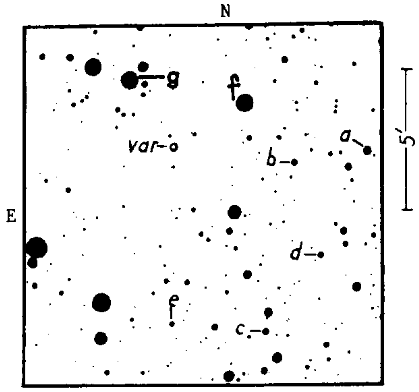


Figure 1

The y = V magnitudes and the colour indices of the variable are given in Table II. The r.m.s. errors for both nights amount to ±0.018, ±0.028, ±0.026, and +0.024 in V, b-y, m1, and c1, respectively.

On the basis of our photometric results we derived colour excesses and spectral types for both the three comparison stars (see Table I) and the main component of this Algol-type binary. The photometrically derived spectral type of V1156 Cygni is F3 V and the total reddening amounts to E(b-y) = 0.426. Based on these data the distance of V1156 Cygni has been estimated to about 700 pc. This value places the variable inside or behind the dark cloud L815. At present there are only few stars in the neighbourhood (distance < 1^{o}) of the line of sight towards V1156 Cygni for which accurate photometric data are known. From them it can be inferred a sharp increase of interstellar reddening from E(B-V) = 0 in a distance of r ≈ 350 pc to E(B-V) = 0.82 in r ≈ 1700 pc. The existing data do not permit to separate the interstellar reddening from a possible circumstellar reddening within the disk.

Further observations in the optical wavelengths region (preferably in the uvby or UBV photometric systems) as well as in the NIR (spectral passbands R, ... ,Q) are requested. Among others from the IR data the spectral type of the eclipsing component of the variable may be deduced.

C. FRIEDEMANN, H.-G. REIMANN

Universitäts-Sternwarte Jena
Schillergässchen 2
O-6900 Jena, Germany

References:

Friedemann, C. and Löwe, M.: 1990, Inf. Bull. Variable Stars No. 3516

Reimann, H.-G., Böhm, M., Pfau, W.: 1989, Astron. Nachr. 310, 41

Wachmann, A.A.: 1966, Astron. Abh. Hamburger Sternwarte Bd. 6, No. 4

Woroschilov, V.I., Kalandadse, N.B., Kolesnik, L.N., Politschuk, E.P., Fedortschenko, G.L.: 1969, Catalogue of B and V magnitudes of 12000 stars, Main Astronomical Observatory Kiew

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3550

Konkoly Observatory
Budapest
2 January 1991

HU ISSN 0374 - 0676

SIMULTANEOUS TWO-COLOUR OBSERVATION OF THE FLARE STAR EV Lac IN AUGUST 1990

Photoelectric monitoring of flare star EV Lac was carried out on 27 - 28 August with the help of the two-channel photoelectric photometer attached on the Cassegrain focus of the 2.6 m telescope of Byurakan Astrophysical Observatory.

Registration was simultaneous in both U and B colours with time resolution 0.1 sec. Algorithm of the observations is described (Zalinian V. and Tovmassian H., 1987; Tovmassian H. and Zalinian V., 1988; Zalinian V., 1988).

On 29 August 1990 a flare of nearly 4 sec duration was recorded in U colour. The light curve and colours of flare are given in Figures 1 and 2. In Fig. 2 the light curve of the flare is averaged over 5 points. The light curve shows that the flare in U colour consists of two maxima, which are better visible in Fig. 2. Amplitudes of flare $\Delta U = 0\overset{m}{.}77$, time of increase 1.5 sec. The flare practically could not be observed in the B colour.

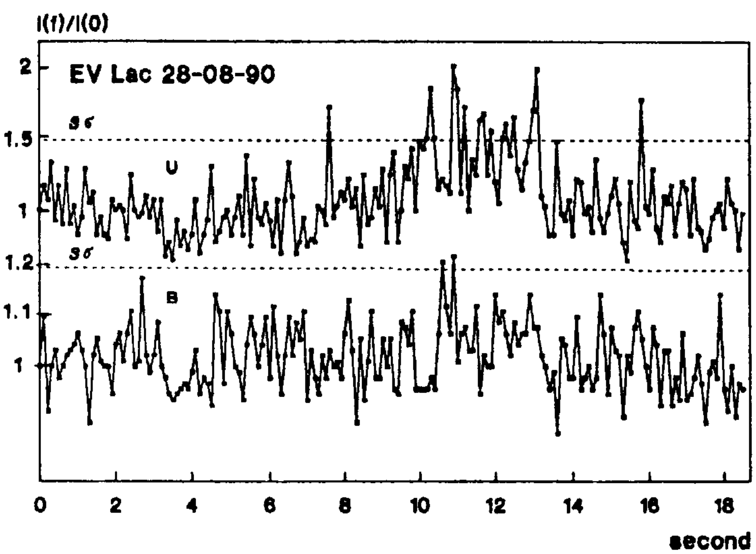


Figure 1

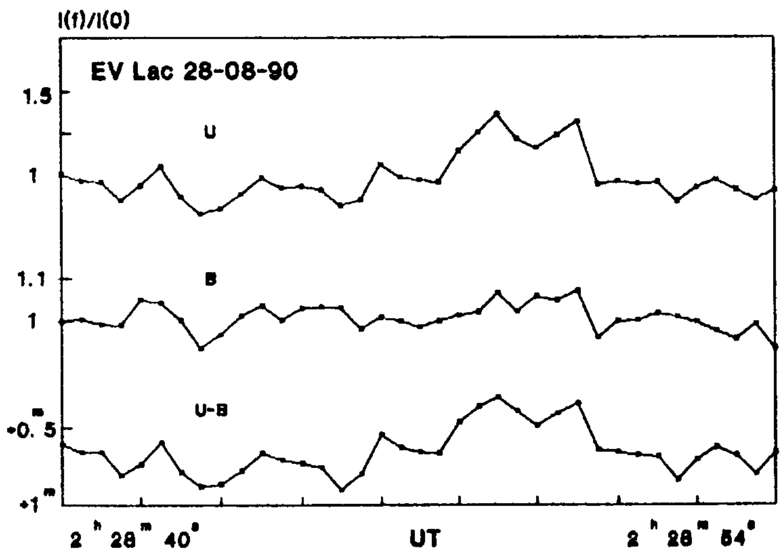


Figure 2

KARAPETIAN A., ZALINIAN V.
Byurakan Astrophysical Observatory
Byurakan, Armenia

References:

Tovmassian, H., Zalinian, V.: 1988, Astrofisica, v.28, 131.
Zalinian, V.: 1988, IBVS No. 3142.
Zalinian, V., Tovmassian, H.: 1987, IBVS No. 2992.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3551

Konkoly Observatory
Budapest
4 January 1991
HU ISSN 0374 - 0676

1987 - 1989 UBV PHOTOMETRY OF OO AQUILAE

New UBV observations of a contact binary OO Aql were made in 1987,1988 and 1989 observing seasons with a single channel photometer attached to the 30 cm Maksutov telescope of the Ankara University Observatory. The same comparison star BD +8° 4220 was chosen as in Demircan and Güdür (1981), and Lafta and Gringer (1985) for nearness in position and brightness to OO Aql. However its spectral type A2 is much earlier than the spectral type G5 of OO Aql. The differential extinction correction of the brightness measurements was found negligibly small, due to proximity of the comparison star to OO Aql. The times of the individual observations were also corrected for the light time variation by reducing them to the Sun's center and the phases were calculated by using the light elements given by Demircan and Güdür (1981), as

$$\text{Min I JD Hel. } 2442218.51607 + 0^{d}.5067848 \times E$$

Altogether 488, 494 and 494 differential magnitudes of OO Aql in U,B and V bandpass, respectively were obtained. The observations are shown in Fig. 1 together with the (B-V) and (U-B) color curves. The light curves in Fig.1 show that the eclipses seem partial although Hrivnak's (1989) solution of the Binnendijk's (1968) light curves requires about seven minutes totality in the secondary minimum. The present observations are, in fact, not sensitive to distinguish such short time totality. This prediction could be checked by more sensitive observations in the secondary minimum. The second important point seen in the light curves is the bandpass independent large depths(1.0 and 0.8 mag.) of the primary and secondary minima. An O'Connell

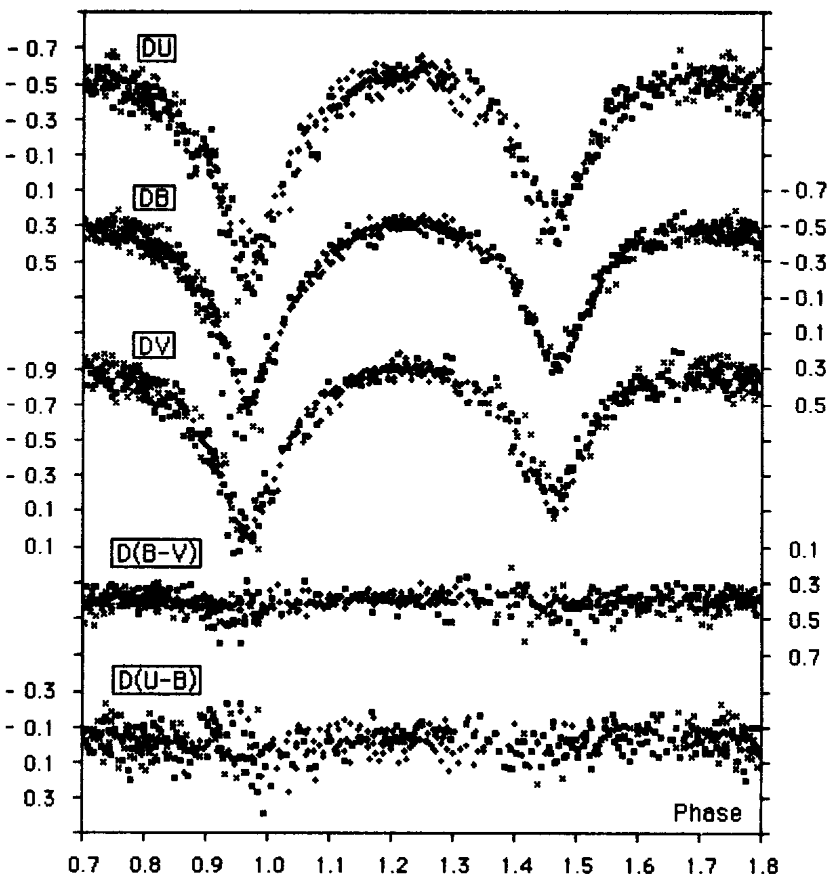


Figure 1. The light and color curves of OO Aql. The cross (x), plus (+), and the square (□) signs are used for the observations of 1987, 1988 and 1989 observing seasons, respectively.

effect as 0.05 mag higher primary maximum is also observable which is probably due to non-homogeneously distributed magnetic starspot activity or a mass transfer from hotter primary to cooler secondary. The system is shown spectroscopically as an A-type contact binary by Hrivnak (1989). The spectroscopic mass ratio q=0.843 of the components obtained by the same author is one of the largest among the contact binaries is not much different from previously obtained photometric value q=0.824 by Twigg (see Mochnacki 1981). Other photometric observations, all in B and V bandpass, were obtained by Binnendijk (1968), Demircan and Güdür (1981), and Lafta and Gringer (1985). The spectroscopic observations by Hrivnak (1989) showed that the system has G5 spectral type and has no obvious Ca II emission as a measure of magnetic activity.

Our observations show slight reddening in both minima (see the color curves in Fig. 1), and the level of maxima and minima, and thus depths of minima are all variable in time.We think the system deserves further more systematic observations in order to understand the time dependent variability.

We thank to G. Kahraman for the generous help during the observations and their reductions.

O. DEMİRCAN
E. DERMAN
F. EKMEKÇİ

Ankara University Observatory
Science Faculty, Tandoğan
06100 Ankara/ Turkey

REFERENCES

Binnendijk, L. :1968, Astron. J.,**73**, 32.

Demircan, O., Güdür, N.:1981, in Photometric and Spectroscopic Binary Systems, eds. E.B. Carling and Z. Kopal, D.Reidel Publ., p. 413.

Hrivnak, B.:1989, Astrophys. J., **340**, 458.

Lafta, S.J., Gringer, J.F.:1985, Ap. Space Sci., **114**, 23.

Mochnacki, S.W.:1981 Astrophys. J., **245**, 650.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3552

Konkoly Observatory
Budapest
7 January 1991
HU ISSN 0374 - 0676

TIMES OF MINIMUM LIGHT FOR 17 ECLIPSES OF 7 DETACHED BINARIES

We report here on the continuation of a program of observing eclipsing binary systems suggested by Herczeg (1980), as systems that may show unusual period changes, or systems which have not been observed frequently enough to confirm period changes.

The observations were made with the 46-cm reflector at Appalachian State University's Dark Sky Observatory. The photometer is a Kitt Peak National Observatory single-channel design employing a thermoelectrically cooled EMI 9865QB photomultiplier tube with matching UBVR filters. An Astronomical Time Mechanisms Model 240V amplifier provides a voltage-to-frequency output that is integrated by a microcomputer.

The observations for a given eclipse were made through one filter only, to maximize the number of data points. The observations have not been transformed to the Johnson system, since they were only intended for timing analysis. The observations are available from the IAU Archives, file number 213.

The times of minimum light and standard errors given in Table I were calculated using the method of Kwee and van Woerden (1956), using a program written by Ghedini (1982). This algorithm has been shown by Caton (1989) to give the most accurate estimation of time of conjunction for asymmetric or distorted light curves.

We gratefully acknowledge the partial support provided by NSF Grant AST-8705770.

Table I

System	Type of Eclipse	Heliocentric JD (-2400000)	Comparison Star	Filter
RT And	Primary	47082.75694 ±0.00061	BD +52°3384	V
RX Ari	Primary	47121.58061 ±0.00023	BD +21°0311	V
	Secondary	47208.57714 ±0.00096	" " "	V
	Primary	47473.71053 ±0.00028	" " "	V
WW Aur	Primary	46840.73088 ±0.00016	BD +32°1320	R
AW Cam	Secondary	47543.75928 ±0.00021	BD +69°0390	R
	Primary	47596.59558 ±0.00076	" " "	R
	Primary	46836.81707 ±0.00031	" " "	R
	Primary	46877.70027 ±0.00014	" " "	R
	Primary	46894.67054 ±0.00037	" " "	R
	Primary	47184.69471 ±0.00050	" " "	V
RX Her	Secondary	46926.76777 ±0.00047	BD +11°3481	V
TX Her	Primary	46877.84439 ±0.00037	BD +42°2822	R
	Primary	47324.82068 ±0.00013	" " "	V
	Primary	46974.65447 ±0.00031	" " "	R
CM Lac	Primary	47073.72594 ±0.00034	BD +43°4110	V
	Primary	47508.59652 ±0.00048	" " "	V

DANIEL B. CATON, WANDA C. BURNS, R. LEE HAWKINS

Dark Sky Observatory
Department of Physics and Astronomy
Appalachian State University
Boone, North Carolina 28608 U.S.A.

References:

Caton, D. B. (1989), Bull. A. A. S. **21**, No.1, 714.

Ghedini, S. (1982). Software for Photometric Astronomy, Willman-Bell, Richmond, VA, p. 46.

Herczeg, T. J. (1980), in Close Binary Stars: Observations and Interpretation, ed. M. K. Plavec, D. M. Popper and R. K. Ulrich, (Dordrecht: Reidel), 89.

Kwee, K. and van Woerden, H. (1956). B.A.N. **12**, 327.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3553

Konkoly Observatory
Budapest
10 January 1991
HU ISSN 0374 - 0676

DISCOVERY OF RAPID OSCILLATIONS IN HD 19918

The southern ($\delta = -82^{o}$) Ap SrEuCr (Houk & Cowley 1975) star HD19918 was monitored photometrically for 2.2 hr on the night of 6/7 October 1990 (JD2448171) as part of the Cape Rapidly Oscillating Ap star survey. The scope and goals of the survey as well as the first results are described in a separate publication by Martinez, Kurtz & Kauffmann (1991). HD19918 is the sixth rapidly oscillating Ap (roAp) star to emerge from the survey since its beginning in May 1990.

The photometry was obtained using the University of Cape Town photometer attached to the 0.75-m telescope of the South African Astronomical Observatory (SAAO) in Sutherland. The observations comprise continuous 10-s integrations through a Johnson *B* filter and a 30 arcsec diaphragm with occasional interruptions for sky measurements. Because we were searching for oscillations on time-scales of 5-15 min we did not observe comparison stars and no attempt was made to transform our observations to the standard system.

The reduction procedure was as follows: The data were corrected for coincidence-counting losses, sky background and extinction, in that order. Because no comparison stars were observed the data contain variations on time-scales of 0.5 hr which were introduced by sky transparency variations. On good nights these sky transparency variations will be of sufficiently low amplitude and be gradual enough not to interfere with our search for rapid oscillations. Their effect is simply to introduce a few high amplitude (1-4 mmag) peaks at low frequencies ($\nu \leq 0.6$ mHz) in the Fourier transform of the observations (See Fig. 1). The Fourier transforms presented in this Bulletin were computed using Deeming's (1975) Discrete Fourier Transform algorithm with the modification suggested by Kurtz (1985).

In Figure 1(a) we present the amplitude spectrum of the observations of HD 19918 on JD2448171 out to 12.5 mHz. Normally we would remove the low frequency sky transparency peaks, but we deliberately show them in Fig. 1 so that the reader may judge the data. The peak marked ν_1 suggests the presence of rapid oscillations at 1.5 mHz with an amplitude of 0.9 mmag. We thus observed this star again on the nights JD2448172 and JD2448217 to confirm the presence of rapid oscillations at $\nu_1 = 1.5$ mHz. The JD2448172 data do not show a peak at 1.5 mHz but these data were

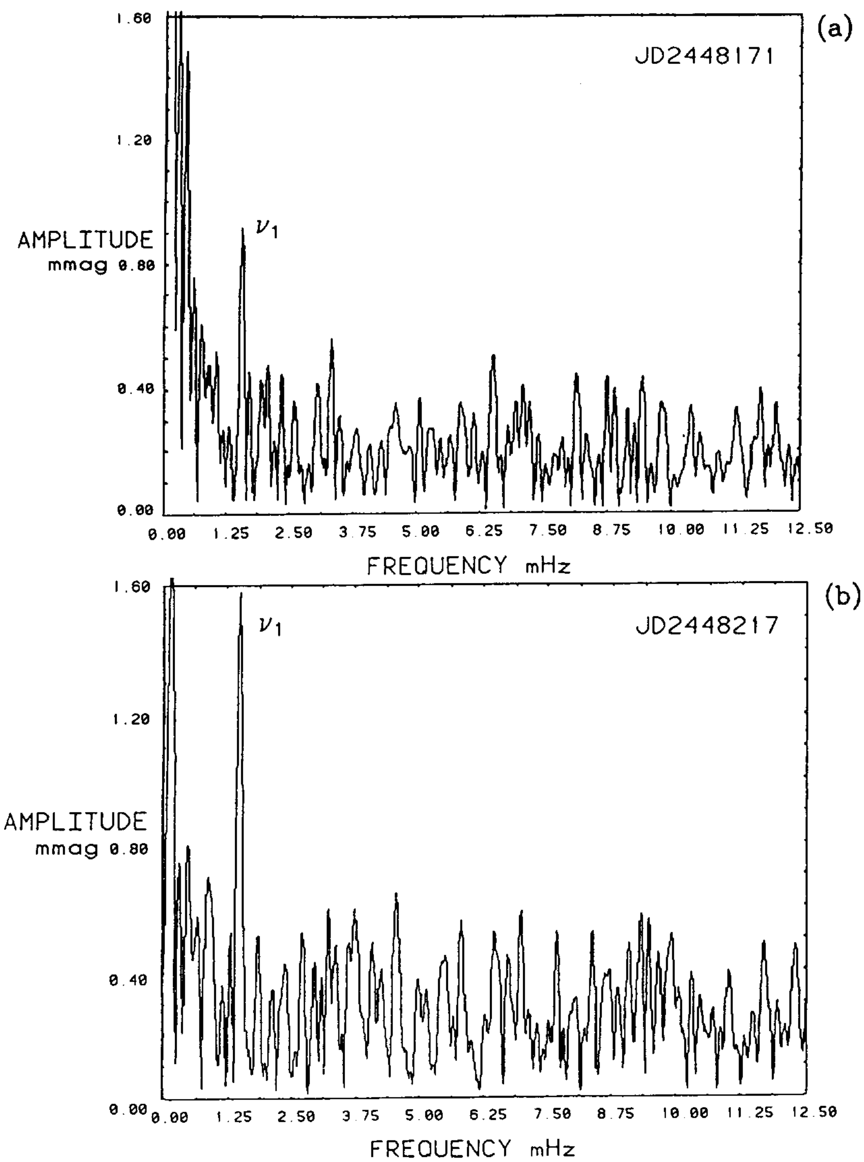

(a)
JD2448171
ν_1
AMPLITUDE
mmag
1.60
1.20
0.80
0.40
0.00
0.00 1.25 2.50 3.75 5.00 6.25 7.50 8.75 10.00 11.25 12.50
FREQUENCY mHz
(b)
JD2448217
ν_1
AMPLITUDE
mmag
1.60
1.20
0.80
0.40
0.00
0.00 1.25 2.50 3.75 5.00 6.25 7.50 8.75 10.00 11.25 12.50
FREQUENCY mHz

Figure 1

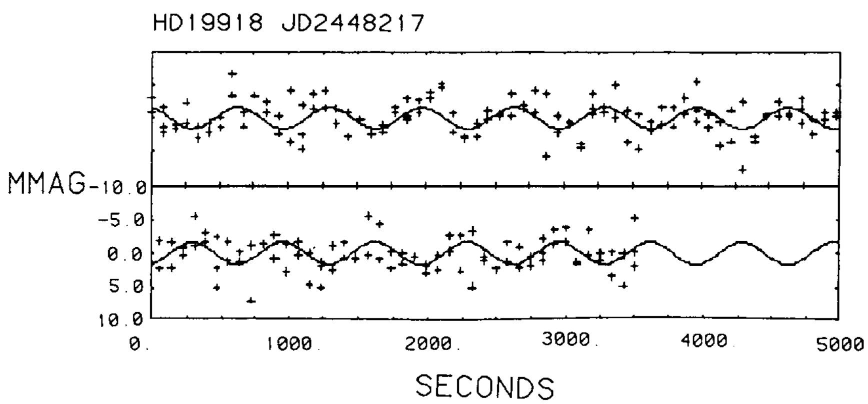


Figure 2

twice as noisy as the data acquired on night JD2448171. We will not discuss the JD2448172 observations further. In Figure 1(b) we present the observations acquired on night JD2448217. The 1.50 mHz peak appears with a very good signal-to-noise in these data. Note the difference in the amplitude of ν_1 in the two panels of Fig. 1. Such amplitude modulation is commonly observed in the roAp stars. It arises in the following ways: (1) through the beating of two, or more, unresolved oscillation frequencies, (2) though the oscillations being observed with changing aspect as the star rotates or (3) through intrinsic variations in the amplitude of the oscillation frequency. Only a detailed study of the oscillations will reveal relative importance of these factors in HD19918.

In Fig. 2 we present a light curve of the observations acquired on night JD2448217. In order to reduce the point to point scatter we have binned the data to 40-s integrations by taking non-overlapping 4-point averages of the data. We have also removed some low frequency sky transparency variations to facilitate the reader's perception of the oscillations. The solid line is a least squares fit to the data of a sinusoid with frequency $\nu_1 = 1.50$ mHz and an optimized amplitude of 1.61 mmag. The fit is reasonably good.

As of this writing we have high-speed observations of HD 19918 on 8 other nights, most of which show the 1.50 mHz peak at a good signal-to-noise. One must bear in mind that nights of excellent photometric quality are needed to study the rapid oscillations in HD 19918 because the lowest airmass attained by this $\delta = -82°$ star at Sutherland is 1.54. Further observations and a detailed frequency analysis of the oscillations of HD 19918 will be presented in a future publication.

PETER MARTINEZ and D.W. KURTZ

Dept. of Astronomy; Univ. of Cape Town
Rondebosch, 7700 South Africa

4

References

Houk, H & Cowley, A.P., 1975. *Michigan Spectral Catalogue of Two-Dimensional Spectral Types for the HD Stars. Volume 1*, Dept of Astronomy, University of Michigan.

Deeming, T.J., 1975. *Astrophys. Space Sc.*, **36**, 137.

Kurtz, D.W., 1985. *Mon. Not. R. astr. Soc.*, **213**, 773.

Martinez, P., Kurtz, D.W. & Kauffmann, G., 1991. *Mon. Not. R. astr. Soc.*, in press.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3554

Konkoly Observatory
Budapest
16 January 1991
HU ISSN 0374 - 0676

FIRST PHOTOELECTRIC LIGHTCURVES IN TWO COLORS AND IMPROVED ELEMENTS FOR V482 PERSEI AND V651 CASSIOPEIAE

(BAV Mitteilung Nr.55)

In this paper we report on results of our photoelectric work on two variables in Perseus and Cassiopeia. The observations were made at the private observatory of F. Agerer with an 0.35m automatic photoelectric telescope. For a description see Agerer (1988). The photometer was equipped with an uncooled EMI 9781 B PMT. Schott Filters BG12 1mm + GG 385 2mm were used for B and GG 495 1mm for V. The diaphragm measured 32". Instrumental magnitude differences were converted to the international UBV-system. Minimum timings are calculated with the Kwee - van Woerden method.

V 482 Persei

V 482 Per = BD+47°961(9$^{m}_{.}$4) = S8552 = NSV01525 was announced as variable by Hoffmeister (1966). He published time of one significant plate weakening and classified the type of variability as probably irregular. First investigation of V482 Per was conducted by Harvig and Leis (1981). They studied the variable on 237 plates from the Tartu observatory, discovered the eclipsing nature of variability with a range between 10$^{m}_{.}$90 and gave a first lightcurve. From four normal minima, together with the plate minimum by Hoffmeister, they give first elements as

$$\text{Min I} = \text{JD } 2428327.653 + 2^{d}_{.}446798 \cdot E.$$

The variable got its definitive name in the 67th name-list of variable stars (Kholopov et al. 1985). V 482 Per is not comprised in the fourth edition of the General Catalogue of Variable Stars (Kholopov et al. 1987). The small extent of the observational material made us put V 482 Per on our program.

We observed V 482 Per on 18 nights between Nov. 1988 and Nov. 1990 in B and V. BD+46°860 = SAO 039439 (F8) served as comparison star and BD+47°962 to check its constancy. Five primary and one secondary minima could be secured (Table I). Using the method of (weighted) least squares, we calculated from these timings, together with the normal minima by Harvig and Leis, the following refined elements:

$$\text{Min I} = \text{JD } \underset{\pm 2}{2428327.764} + \underset{\pm 3}{2^{d}_{.}4467549} \cdot E.$$

The lightcurve is reduced with these elements from almost 900 measurements in each colour (Fig. 1).

V 651 Cassiopeiae

V 651 Cas = BV326 = CSV8883 = NSV14717 was discovered by Strohmeier and Knigge (1960). They classify it as an eclipsing binary in the range between $11^{m}.1$ and $11^{m}.6$ and give a finding chart. The variable was studied again by Berthold (1983) on 193 Hartha sky-patrol plates. The author suspected W UMa type variability and a sudden change of period occurring in Oct. 1965. First elements and a mean lightcurve with photographic magnitudes between $10^{m}.5$ and $11^{m}.0$ were communicated. The variable got its current name in the 67^{th} name-list of variable stars (Kholopov et al. 1985). V651 Cas is not comprised in the fourth edition of the General Catalogue of Variable Stars (Kholopov et al. 1987). Extensive spectroscopy of the variable by Wenxian Lu (1986) showed that the period has to be doubled. New elements were given as:

$$\mathrm{Min} = \mathrm{JD}\ \underset{\pm 22}{2446430.3159} + \underset{\pm 41}{0^{d}.996864} \cdot E.$$

Lu also questioned the W UMa type classification. As a consequence, Berthold (1988) re-examined the star on all Hartha sky-patrol plates and amplified this material with plates from the Sonneberg sky-patrol, covering a timespan of 54 years. From 23 deep minima Berthold published new elements:

$$\mathrm{Min} = \mathrm{JD}\ \underset{\pm 4}{2446430.305} + \underset{\pm 4}{0^{d}.9968089} \cdot E.$$

To get a complete photoelectric lightcurve, we put V 651 Cas on our program. V 651 Cas was observed on 11 nights between Nov. 1988 and Nov. 1990 in B and V. BD+57°2816 (KO) was used as comparison star and BD+56°3093 was used to check its constancy. Three primary and three secondary minima could be observed (Table II). The depth of primary minimum is $0^{m}.80$ and that of secondary minimum is $0^{m}.31$. Using the 23 photographic minima from the revised list of Berthold (1988), the mean spectrographic epoch given by Lu and our own 6 photoelectric epochs, we calculated the new elements with the method of (weighted) least squares:

$$\mathrm{Min} = \mathrm{JD}\ \underset{\pm 8}{2448205.6322} + \underset{\pm 8}{0^{d}.9968096} \cdot E.$$

The lightcurve (Fig. 2) was reduced with these elements, which are almost identical with the elements given by Berthold (1988). The slope in normal light (Fig. 3) measured on Nov. 4, 1988, which is not due to variations of the comparison star, and also the increased scatter in some parts of the lightcurve, may be due to the RS CVn characteristics of V 651 Cas, which was

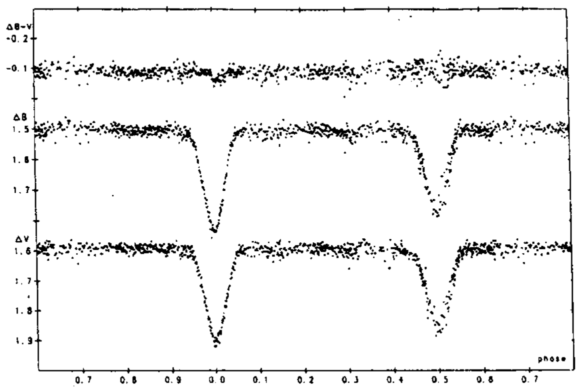


Figure 1

Differential B and V light and B-V color curves of V482 Per

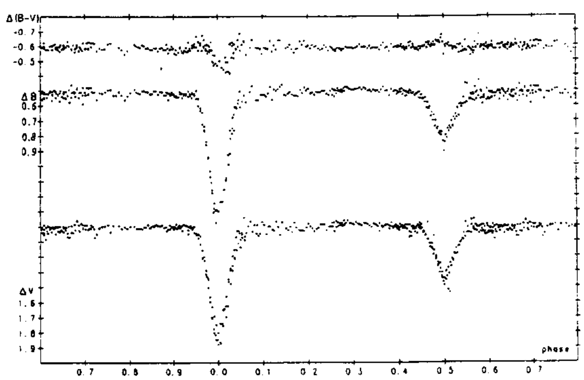


Figure 2

Differential B and V light and B-V color curves of V651 Cas

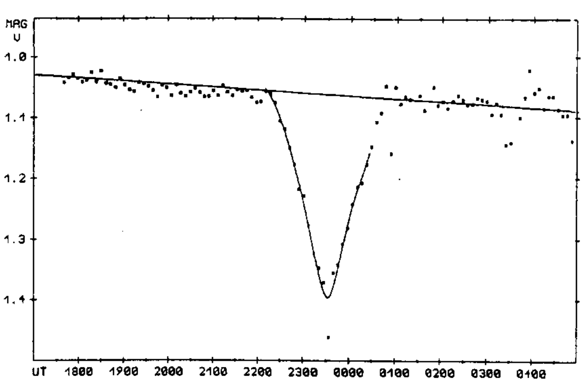


Figure 3

Minimum of V651 Cas, observed on Nov. 4/5, 1988

indicated by Lu (1986). Further monitoring will be necessary to ascertain the possible presence of a low amplitude distortion wave in the light curve.

Table 1. Observed times of minima for V 482 Per, epochs and residuals computed with respect to the ephemeris derived in this paper

No.	JD helioc.	Weight	Type	Epoch	(O-C)	Observer	Source
1	2428327.655	0	p::	0	-0.109	C.Hoffmeister	AN 289.1
2	34070.291	1	F	2347	-0.006	Harwig & Leis	PTAO 48.175
3	34149.808	1	F	2379.5	-0.009		
4	35239.850	1	F	2825	0.004		
5	35321.826	1	F	2858.5	0.013		
6	2447565.3737	10	E	7862.5	-0.0006	F.Agerer	this paper
7	47823.5048	10	E	7968	-0.0022		
8	47840.636	5	E:	7975	0.0018		
9	47850.4210	10	E	7979	-0.0003		
10	47943.4012	10	E	8017	0.0032		
11	48222.3268	10	E	8131	-0.0012		

p denotes pg plate min., F photographic minimum and E photoelectric min. The minimum marked ":" received reduced weight, while that marked "::" was discarded.

Table 2. Observed times of minima for V 651 Cas, epochs and residuals computed with respect to the ephemeris derived in this paper

No.	JD helioc.	Weight	Type	Epoch	(O-C)	Observer	Source
1	2426743.311	1	p	-21531	-0.013	T.Berthold	MHAR 21.9
2	27060.327	1	p	-21213	0.017		
3	27063.324	1	p	-21210	0.024		
4	31413.389	1	p	-16846	0.012		
5	31673.534	1	p	-16585	-0.011		
6	33864.527	1	p	-14387	-0.005		
7	33888.451	1	p	-14363	-0.005		
8	34191.498	1	p	-14059	0.012		
9	35509.265	1	p	-12737	-0.003		
10	35551.624	1	p	-12694.5	-0.009		
11	36378.470	1	p	-11865	-0.016		
12	36394.419	1	p	-11849	-0.016		
13	36395.440	1	p	-11848	0.008		
14	36400.421	1	p	-11843	0.005		
15	37016.431	1	p	-11225	-0.013		
16	37045.351	1	p	-11196	-0.001		
17	39027.509	1	p	-9207.5	0.001		
18	39029.501	1	p	-9205.5	-0.000		
19	40152.403	1	p	-8079	-0.004		
20	44254.268	1	p	-3964	-0.011		
21	44256.256	1	p	-3962	-0.016		
22	2446430.316	5	S	-1781	0.002	Wenxian Lu	IBVS 2868
23	46713.391	1	p	-1497	-0.017	T.Berthold	MHAR 21.9
24	46714.411	1	p	-1496	0.006		
25	2447470.4858	10	E	-737.5	0.0007	F.Agerer	this paper
26	47769.5299	10	E	-437.5	0.0020		
27	47975.3689	10	E	-231	-0.0002		
28	47983.3450	10	E	-223	0.0014		
29	48093.4913	10	E	-112.5	0.0002		
30	48205.6326	10	E	0	0.0004		

p denotes pg plate min. (weight 1), S the spectroscopic min. by Lu (weight 5) and E photoelectric min. (weight 10).

F. AGERER D. LICHTENKNECKER †

Berliner Arbeitsgemeinschaft für
veränderliche Sterne e.V. (BAV)
Munsterdamm 90, D-1000 Berlin 41

References:

Agerer, F.: 1988, BAV Rundbrief 37(2), 60.
Berthold, Th.: 1983, Mitt. Hartha, Heft 18.
Berthold, Th.: 1988, Mitt. Hartha, Heft 21.
Harvig, V., Leis, L.: 1981, Publ. Tartu Astrof. Obs. 43, 172.
Hoffmeister, C.: 1966, Astron. Nachr. 289, 1.
Kholopov, P.N., Samus, N.N., Kazarovets, E.V., Perova, N.B.: 1985, I.B.V.S. No.2681.
Kholopov, P.N. (editor-in-chief) et al.: 1985, General Catalogue of Variable Stars, Vol.1, Moscow: Nauka
Kholopov, P.N. (editor-in-chief) et al.: 1987, General Catalogue of Variable Stars, 4th Ed., Vol.3, Moscow: Nauka
Lu, W.: 1986, I.B.V.S. No.2868.
Strohmeier, W., Knigge, R.: 1960, Veröff. Bamberg, Bd. V(5).

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3555

Konkoly Observatory
Budapest
16 January 1991

HU ISSN 0374 - 0676

PHOTOELECTRIC LIGHTCURVE IN TWO COLOURS AND IMPROVED ELEMENTS FOR V724 AQUILAE

(BAV-Mitteilung Nr.57)

V724 Aql = 798.1933 was detected by Hoffmeister as a short period variable in the range between $11^{m}.0$ and $11^{m}.5$ (Hoffmeister, 1934). First investigation of this variable was done by Ahnert on plates of the Sonneberg sky-survey. He classified the variable as a cepheid, communicated 11 times of maximum light with one digit accuracy and elements for maxima (Ahnert et al., 1949). In the course of a photoelectric survey of northern cepheids, the variable proved to be an eclipsing binary of W UMa type (Oosterhoff, 1960). He published a normal lightcurve and the elements:

$$\text{Min} = \text{JD } 2436818.672 + 0^{d}.51752 \cdot E.$$

The low precision elements and the lack of further published observations made V724 Aql an interesting object for us. The variable was observed on eight nights from Aug. 1988 to July 1990 at the private observatory of F. Agerer, with an 0.35m automatic photoelectric telescope. For a description see Agerer (1988). The photometer was equipped with an uncooled EMI 9781 B PMT. Schott filters BG12 1mm + GG 385 2mm were used for B and GG 495 1mm for V. The diaphragm measured 32". BD+1°4146 (FO) served as comparison star and BD+1°4143 to check its constancy. Instrumental magnitude differences were converted to the international UBV-system. Minimum timings are calculated with the Kwee - van Woerden method. Two primary and three secondary minima were observed (Table I). As both minima are of nearly equal depth, the distinction between them is uncertain. From our observations and the normal minimum by Oosterhoff we calculated improved elements using the method of (weighted) least squares as:

$$\text{Min} = \text{JD } \underset{\pm 5}{2436818.6721} + \underset{\pm 2}{0^{d}.51760028} \cdot E.$$

With these elements we reduced the photoelectric lightcurve (Fig. 1).
Using the maximum timings by Ahnert, we calculated the times of the following minimum by adding P/4. The resulting O-C's seem to confirm the period found (Table I).

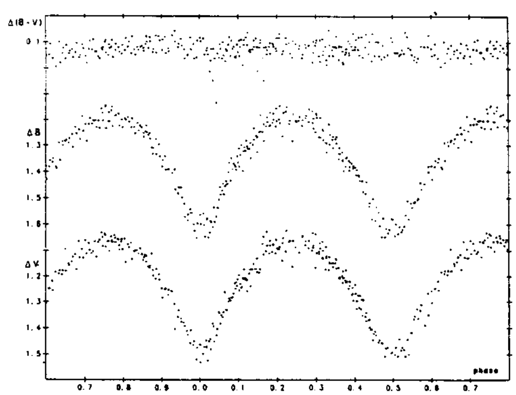


Figure 1 Differential B and V light and B-V color curves of V724 Aql

Table 1. Observed times of minima for V 724 Aql, epochs and residuals computed with respect to the ephemeris derived in this paper

No.	JD helioc.	Weight	Type	Epoch	(O-C)	Observer	Source
1	2426945.53	0	p	-19075	0.08	P.Ahnert (+P/4)	VSS 1.3
2	27277.53	0	p	-18433.5	0.04		
3	27633.53	0	p	-17745.5	-0.07		
4	28034.53	0	p	-16971	0.05		
5	28070.43	0	p	-16901.5	-0.02		
6	28422.43	0	p	-16221.5	0.01		
7	29024.73	0	p	-15058	0.08		
8	29102.63	0	p	-14907.5	0.08		
9	29158.53	0	p	-14799.5	0.08		
10	29923.43	0	p	-13321.5	-0.03		
11	30932.13	0	p	-11373	0.13		
12	2436818.672	10	E	0	-0.0001	P.T.Oosterhoff	BAN 15.199
13	47405.415	2	E:	20453.5	0.0057	F.Agerer	this paper
14	47412.3980	10	E	20467	0.0009		
15	47413.4320	10	E	20469	-0.0003		
16	48097.4413	10	E	21790.5	0.0002		
17	48098.4744	10	E	21792.5	-0.0019		

p denotes pg plate max. + P/4 to get time of next minimum (weight 0),
E photoelectric min. The minimum marked ":" received reduced weight.

F. AGERER D. LICHTENKNECKER†

Berliner Arbeitsgemeinschaft für
veränderliche Sterne e.V. (BAV)
Munsterdamm 90, D-1000 Berlin 41

References:

Agerer, F.: 1988, BAV Rundbrief 37(2), 60.
Ahnert, P., Hoffmeister, C., Rohlfs, E., van de Voorde, A.: 1949, Veröff. Sternw. Sonneberg, 1, Nr.3.
Hoffmeister, C.: 1934, Astron. Nachr., 251, 23.
Oosterhoff, P.Th.: 1960, Bull. Astron. Inst. Netherlands, 15, 199.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3556

Konkoly Observatory
Budapest
17 January 1991
HU ISSN 0374 - 0676

CG CYGNI REDUX: MORE 1989 BVR DATA

Our 1989 July and August BVR light curves of CG Cygni (= BD + 34° 4217 = #142 in the catalog of Strassmeier *et al.* 1988) exhibited small "waves" (Beckert *et al.*, 1989). To confirm that these peculiar features were real (rather than instrumental or weather-generated artifacts), we decided to re-observe this short-period RS CVn system as soon after as possible on 10 and 11 Sept., 13 Oct., and 11 and 13 Nov., 1989. We note that our earlier data were obtained on different nights with overlapping phase coverage, yet the small-scale structure matched smoothly. Also, we tracked the instrumental magnitude of the comparison star and found it constant within statistical fluctuations. Finally, observations of RT And done at about the same time with the same system showed no such small waves. These facts support the claim that the "waves" originated in the binary system rather than in the instrumentation or from the observing technique.

We used our 60-cm Capilla Peak telescope with a CCD camera (Laubscher *et al.*, 1988) in the mode of a multichannel photometer with our new filter set (Beckert and Newberry, 1989). Data were reduced with a softward mask for an effective aperture of 30 arcsec. The orbital phases were calculated from the ephemeris of Strassmeier *et al.* (1988).

Figures 1-3 present the data (converted from instrumental magnitudes to normalized intensity units) at BVR. As before, the statistical error in each datum is less than 0.01 mag. In fact, tests of our CCD system indicate that for *V*-band exposures of 30 seconds, the S/N for a system of the magnitude of CG Cyg is about 500. Hence, our differential photometry is the most precise done to date and can reliably detect phenomenon at the level of 0.01 mag. To provide a baseline for comparison, Figures 1-3 also include an optimized binary model fit (solid line) for $i = 82.8°$, and photospheric temperatures T_1 = 5300 K, and T_2 = 4600 K.

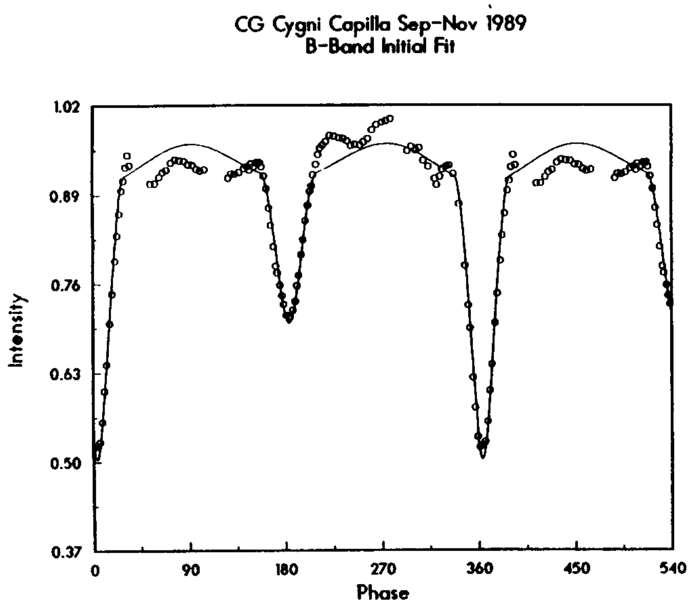


Figure 1

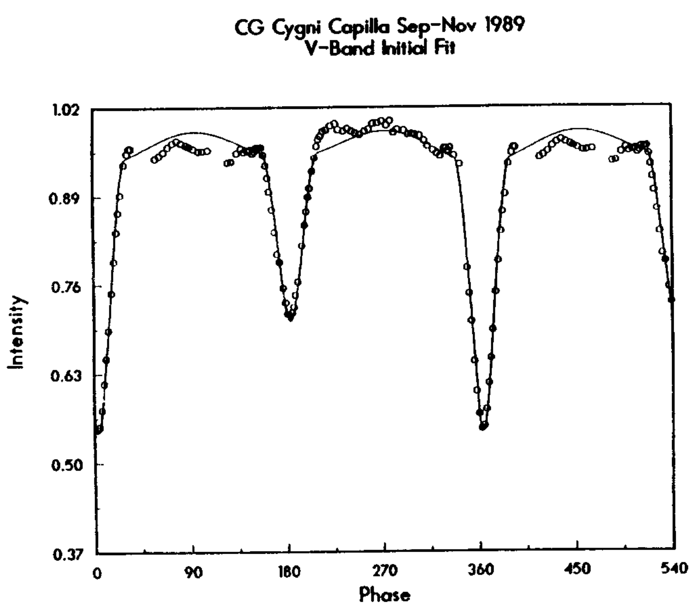


Figure 2

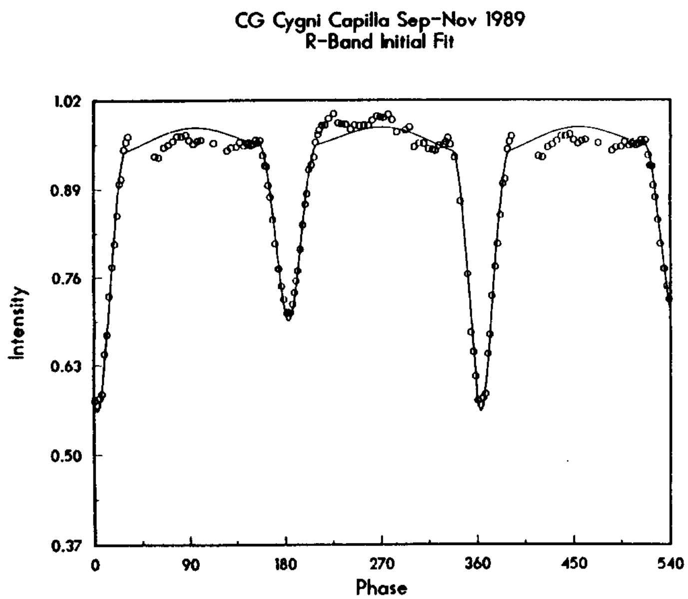


Figure 3

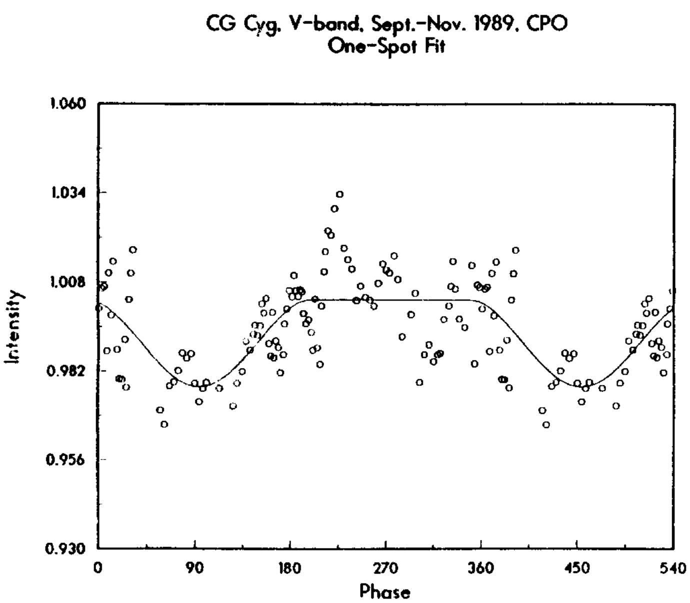


Figure 4

We can plainly see that the small "waves" are still visible, though not as clearly defined as in our previous data. The peaks and troughs on the 90° shoulder match very well those seen before; the fit is not good on the 270° shoulder. The peak-to-peak amplitude is about the same. Hence, we conclude that these small-scale features arise in the binary system, though we have no obvious physical mechanism.

Following Budding and Zeilik (1987), we apply a black, circular spot model to represent the maculation effect. For *V*-band, our optimized fit gives: longitude = 96.2° ±4.3°, radius = 16.2° ±2.9° and latitude = 60.0° ± 2.9°. Figure 4 shows the results. Within the errors, the longitude is the same as that for July-August (88.6° ±3.5°) and also the radius (15.6° ±0.5°). Using the *B* and *R* band data, we infer a temperature difference between the spotted region and the photosphere of 1060K ± 170K, similar to that found before (1140K ± 160K).

This work was supported in part by NSF grant AST-8901374 to MZ.

D. BECKERT, S. GORDON, E. JADERLUND,
E. MANN and M. ZEILIK
Capilla Peak Observatory
Institute for Astrophysics
The University of New Mexico
Albuquerque, NM 87131
U.S.A.

References:

Beckert, D.C. and Newberry, M.V., 1989, *Pub Astron. Soc. Pac.*, **101**, 849.

Beckert, D., Cox, D., Gordon, S., Ledlow, M., Zeilik, M., 1989, *Inf. Bull. Var. Stars,* No. 3398.

Budding, E. and Zeilik, M., 1987, *Astrophys. J.,* **319**, 827.

Laubscher, B.E., Gregory, S. Bauer, T.J., Zeilik, M. and Burns, J.O., 1988, *Pub. Astron. Soc. Pac.*. **100**, 131.

Strassmeier, K.G., Hall, D.S., Zeilik, M., Nelson, E., Eker, Z., and Fekel, F.C., 1988, *Astron. Astrophys. Suppl. Ser.*, **72**, 291.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3557

Konkoly Observatory
Budapest
18 January 1991
HU ISSN 0374 - 0676

MISCLASSIFIED RV TAURI STARS

An RV Tauri variable, according to the definition given in the GCVS (Kholopov 1985) is a giant or supergiant, and it should have (1) a maximum and minimum spectral type of F–G and K–M, respectively, (2) a formal period between 30 and 150 days, and (3) its light curve is supposed to show alternating deep and shallow minima. It is interesting to know if the stars classified as RV (or RV:) satisfy these conditions.

Since numerous RV Tau variables have no published photometry or light curve only the first two conditions (spectral type and period) are considered here. Table I lists those stars whose spectra, as given in the GCVS, are M-type.

The extensive spectroscopic surveys of Rosino (1951) and Joy (1952) show that RV Tau stars have spectral types between F and K (from maximum to minimum). This result was confirmed later by Preston *et al.* (1963). There are, however, two stars with conflicting spectral types: for DY Aql and RV Tau Joy (1952) gave G5–K0 and G4–K1, respectively, while Preston *et al.* (1963) classified them, at certain phases, as M.

Table II lists those stars whose period is greater than 150^d. The real upper limit (if there is such) of the periods of RV Tau stars is clearly not 150^d, so stars like QV Aql, RU Hyi, or HZ Sgr could belong to this class.

There are four stars common in both Tables: BI Cep, V609 Oph, V794 Sgr, and LU Sct. These stars are almost certainly not RV Tau variables (Lovell (1989) published photographic light curves of V794 Sgr showing *equal* minima but unequal maxima).

In conclusion, apart from QV Aql, RU Hyi, and HZ Sgr, all stars listed in Table I and Table II are probably not RV Tau variables. Since a lot of RV Tau stars have no period and spectral type given in the GCVS, the number of misclassifications is certainly higher.

Table I

Star	Spectral type	Star	Spectral type
BI Cep	M5eII	V1541 Sgr	M5
CU Del	M3II	V2342 Sgr	M:
V609 Oph	M6II	V3808 Sgr	M5
V794 Sgr	M3eIa–M4Ia	V3829 Sgr	M3
V1377 Sgr	M2	GK Sct	M
V1462 Sgr	M5	KT Sct	M3
V1472 Sgr	M6	LU Sct	M4
V1486 Sgr	M3		

Table II

Star	Period (day)	Star	Period (day)
QV Aql	169.5	CK Lac	279
V786 Ara	200:	KW Lyr	260
BI Cep	212	V581 Oph	352
EI Cyg	287.6	V609 Oph	195
V1690 Cyg	285	HZ Sgr	163:
OR Her	210	V794 Sgr	175.2
RU Hyi	157	LU Sct	375:

E. ZSOLDOS
Konkoly Observatory
Budapest XII. P.O.Box 67
1525 HUNGARY

References

Joy,A.H. 1952, *Astrophys. J.* **115**,25
Kholopov,P.N. 1985, *General Catalogue of Variable Stars* (4th ed.), Vol. 1, Nauka Publ., Moscow
Lovell,A.J. 1989, *J.AAVSO* **18**,45
Preston,G.W.;Krzeminski,W.;Smak,J.;Williams,J.A. 1963, *Astrophys. J.* **137**,401
Rosino,L. 1951, *Astrophys. J.* **113**,60

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3558

Konkoly Observatory
Budapest
28 January 1991

HU ISSN 0374 - 0676

SPORADIC PHOTOMETRY OF PLEIONE

Pleione (HR 1180, BU Tau) is a renowned B8 V star in the Pleiades that over the past century has variously been an ordinary B-star, a Be star, and a shell star. A shell episode that began in 1972 was still continuing in 1987 (Goraya et al. 1987), and at that time Dr Robert Garrison suggested to me that it would be useful to monitor the star photometrically. I report here Strömgren photometry obtained at this observatory in early 1987 and early 1988. It was obtained differentially with respect to HR 1144 (18 Tau), another B8 V Pleiad that is a Strömgren standard. Differential measures were added to the Strömgren indices listed for the standard in *The Astronomical Almanac* to produce the values in Table 1.

Table 1
Photometry of Pleione

HJD - 2440000	V	b-y	m1	c1	β
6822.541	5.110	-0.033	0.121	0.815	2.605
6837.560	5.089	-0.033	0.113	0.857	2.613
6846.559	5.088	-0.033	0.126	0.884	2.602
6871.587	5.095	-0.030	0.112	0.935	2.597
7225.560	5.089	-0.013	-	-	-
7231.536	5.079	-0.025	0.111	0.714	2.595
7243.543	5.091	-0.012	-	-	-
Means:	5.092	-0.026	0.117	0.841	2.602

There seems evidence for real variability in the c1 index, but not much elsewhere. However, the β index clearly reflects the presence of emission partially filling the line; Pleione, from its membership in the Pleiades, has $Mv = +0.6$, and from the Mv-β relation of Balona and Shobbrook (1984) one would expect $\beta \approx 2.83$. The other indices, including c1, are about normal for the spectral type, however.

J.D. Fernie
David Dunlap Observatory
University of Toronto

References:
Balona, L.A., and Shobbrook, R.R., 1984, *M.N.R.A.S.* 211, 375.
Goraya, P.S., Tur, N.S., and Rautela, B.S., 1987, *I.B.V.S.* No. 3052.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3559

Konkoly Observatory
Budapest
4 February 1991
HU ISSN 0374 - 0676

A NEW FORECAST FOR HS HERCULIS

The first attempt to determine an apsidal period, U, for HS Herculis was undertaken by Hall and Hubbard (1971). From a preliminary analysis of observed primary minima, they have computed U=15.5 years. But, soon after this communication, Martynov (1971) emphasized that the apsidal period established by Hall and Hubbard is too short.

By using his determination, $\omega = 116^{\circ}$ for the longitude of periastron and taking into consideration the spectroscopic value, $\omega = 37^{\circ}$ (see Cesco and Sahade, 1944), Martynov has determined U = 110 years.

Lastly, Scarfe and Barlow (1974) are of opinion that the available photometric data do not put in evidence any effect of apsidal motion "and another interpretation of the variation in times of minima is required".

Now, in Figure 1 we display all O-C differences, which are referring to the linear ephemeris

$$\text{Min.hel.I} = \text{JD}2440146.6008 + 1^{d}.6374333\ E.$$

It is easy to see that the corresponding O-C diagrams for primary and

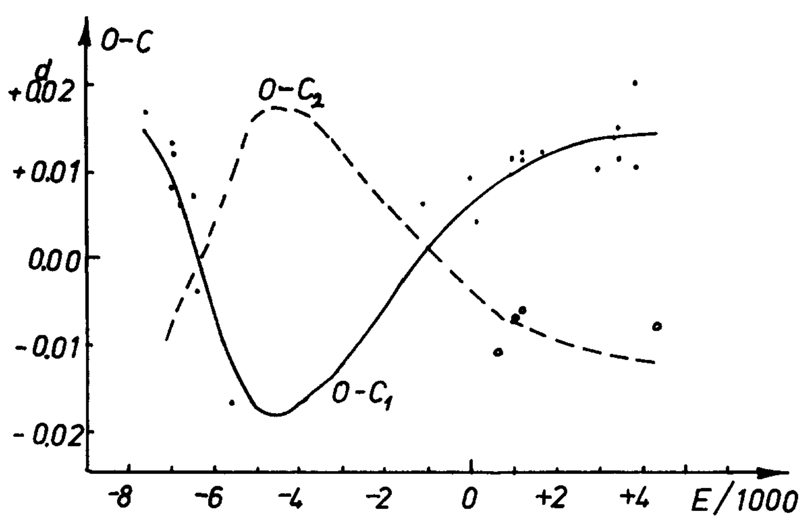


Figure 1

secondary minima (see Fig. 1) are very likely to be caused by a veritable apsidal motion, but the length of the apsidal period is difficult to be determined.

Having in view the above presented remarks, we consider that in the spring of the current year some observers, by performing photoelectric observations, could contribute to an apsidal period determination. That is why we ask for a cooperation in observing the binary system HS Herculis.

IOAN TODORAN

Astronomical Observatory
3400 Cluj-Napoca
Romania

References:

Cesco, C.U., Sahade, G.: 1944, Ap.J., 101, 114.
Hall, D.S., Hubbard, G.S.: 1971, PASP, 83, 459.
Martynov, D.Ya.: 1971, Astron.Circ. (in Russian), No.651.
Scarfe, C.D., Barlow, D.Y.: 1974, PASP, 86, 181.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3560

Konkoly Observatory
Budapest
4 February 1991

HU ISSN 0374 - 0676

BINARY SYSTEM 44i BOOTIS

The binary system 44i Bootis was introduced in the photometric observational program of the Bucharest telescope in 1987, following the IAU indications, about the stars included in Hipparcos program (Dworak and Oblak, 1987).

We have studied the light curve and the period change of this star. Using Duerbeck's ephemeris (1975) we obtained the (O-C) values for a lot of minima between 1975-1990 ($(O-C)_1$ in Table I).

Figure 1 shows a period jump between 1977-1978 and we consider that a new jump was in 1986-1987.

After the first jump we proposed a new period (Oprescu et al., 1989):

$$\text{Min I} = 2443604^{d}.5880 + 0^{d}.26781753\ \text{E}.$$

Using this new ephemeris we reconsidered the (O-C) values ($(O-C)_2$ in Table I). Figure 2 shows the new $(O-C)_2$ aspect. The proposed period was a good one for 1977-1987 interval. After 1987 a change in period was observed. Using a few observations between 1987-1990 we estimate this change:

$$\Delta P = 1^{d}.02666\text{x}10^{-6}$$

and the new ephemeris after 1987 will be:

$$\text{Min I} = 2443604^{d}.5880 + 0^{d}.26781856\ \text{E}.$$

The period change confirms the existence of "active" and "quiet" intervals in the life of this star. The active period is approximately 3 years and the duration of quiet period is about 7 years. The period change appears in an active interval.

Table I.

Hel.Min.	$(O-C)_1$	E	$(O-C)_2$	E	Filter	Authors
244...						
2531.4512	-0.0015	10003				Duerbeck,
2553.4119	-0.0017	10085				1975
2837.5649	-0.0014	11146				"
2841.5831	-0.0004	11161				"
2953.5306	0.0000	11579				"
3604.5880	-0.0030	14010				Duerbeck
3607.5379	0.0009	14021	0.0020	11		et al.,
3607.8107	0.0059	14022	0.0089	12		1978
3614.3611	-0.0052	14046.5	-0.0022	36.5		Rovithis,
3614.5000	-0.0002	14047	-0.0027	37		1981

Table I (cont.)

Hel.Min. 244...	$(O-C)_1$	E	$(O-C)_2$	E	Filter	Authors
3615.5710	-0.0005	14051	0.0025	41		Rovithis, 1981
3616.3764	-0.0015	14054	0.0045	44		"
3974.4464	0.0019	15391	0.0024	1381		Hopp, Witzigmann,
3974.5788	0.0001	15391.5	0.0010	1381.5		1982
4706.5219	0.0023	18124.5	-0.0012	4114.5		"
4709.4679	0.0023	18135.5	-0.0012	4125.5		"
4345.5067	0.0030	16766.5	0.0016	2766.5		Mikolajewska,
4365.4569	0.0009	16851	-0.0006	2841		Mikolajewski,
4366.5290	0.0018	16855	0.0003	2845		1980
4349.3904	0.0034	16791	0.0020	2781		Bergeat et al., 1984
4351.5314	0.0019	16799	0.0004	2789		"
4354.4773	0.0017	16810	0.0003	2800		"
4355.5500	0.0032	16814	0.0017	2804		"
4356.3523	0.0020	16817	0.0006	2807		"
4366.7971	0.0020	16856	0.0005	2846		Scarfe et al., 1984
4390.9032	0.0047	16946	0.0030	2936		"
4409.7855	0.0060	17016.5	0.0042	3006.5		"
4811.7794	0.0082	18517.5	0.0040	4507.5		"
5473.8187	0.0076	20989.5	0.0085	6979.5		"
5476.9019	0.0099	21001	0.0018	6991		"
5477.8383	0.0090	21004.5	0.0008	6994.5		"
5478.7745	0.0078	21008	-0.0004	6998		"
5488.8162	0.0063	21045.5	-0.0018	7035.5		"
5468.4684	0.0126	20969.5	0.0045	6959.5	B	Pohl, Tunca, 1985
5468.4649	0.0091	20969.5			V	"
5482.5245	0.0084	21022	0.0002	7012	B	"
5482.5259	0.0098	21022			V	"
5870.4565	0.0111	22470.5	-0.0015	8460.5	V	"
6640.3026	0.0174	25345	0.0033	11335	B	Al-Naimiy et al.,
6638.2937	0.0171	25337.5	0.0030	11327.5	B	1986
6640.3005	0.0153	25345			V	"
6638.2939	0.0151	25337.5			V	"
6973.3286	0.0153	26588.5			U	Oprescu et al.,
6973.3296	0.0163	26588.5	0.0006	12578.5	B	1989
6973.3352	0.0218	26588.5			V	"
6977.3550	0.0245	26603.5	0.0074	12593.5	U	"
6977.3510	0.0205	26603.5			B	"
6977.3557	0.0252	26603.5			V	"
6984.3159	0.0221	26629.5	0.0050	12619.5	U	"
6984.3174	0.0236	26629.5			B	"
6984.3235	0.0298	26629.5			V	"
6986.3253	0.0229	26637	0.0058	12627	U	"
6986.3238	0.0214	26637			B	"
6986.3257	0.0233	26637			V	"
7242.4883	0.0200	27593.5	0.0013	13583.5		Rovithis,

Table I (cont.)

Hel.Min. 244...	$(O-C)_1$	E	$(O-C)_2$	E	Filter	Authors
7242.6248	0.0224	27594	0.0039	13584		Rovithis-Livaniou, 1989
7245.4395	0.0252	27604.5	0.0066	13594.5		
7245.5701	0.0219	27605	0.0032	13595		"
7319.7446	0.0114	27881			U	Willmitch, Douglas, 1989
7319.7495	0.0173	27881			B	
7319.7491	0.0159	27881			B	"
7322.7008	0.0217	27892			B	"
7322.6999	0.0208	27892			V	"
7338.3675	0.0211	27951	0.0019	13941.5		Rovithis, Rovithis-Livaniou, 1989
7338.5006	0.0203	27952	0.0011	13942		
7340.3756	0.0206	27959	0.0013	13949		
7341.3174	0.0250	27962.5	0.0058	13952.5		"
7341.4445	0.0182	27963	-0.0010	13953		"
7359.3920	0.0221	28030	0.0027	14020		Surkova, 1990
7364.3469	0.0224	28048.5	0.0030	14038.5		"
7365.4180	0.0223	28052.5	0.0028	14042.5		"
7371.4438	0.0222	28075	0.0027	14065		"
7375.3270	0.0220	28089.5	0.0026	14079.5		"
7388.3163	0.0223	28138	0.0027	14128		"
7393.4050	0.0225	28157	0.0029	14147		"
7739.2988	0.0320	29448.5	0.0104	15438.5	V	This paper
8086.3840	0.0278	30744.5	0.0041	16734.5	U	"
8086.3881	0.0319	30744.5	0.0062	16734.5	B	"
8086.3877	0.0315	30744.5	0.0078	16734.5	V	"
8091.3346	0.0238	30763	0.0001	16753	U	"
8091.3346	0.0238	30763	0.0001	16753	B	"

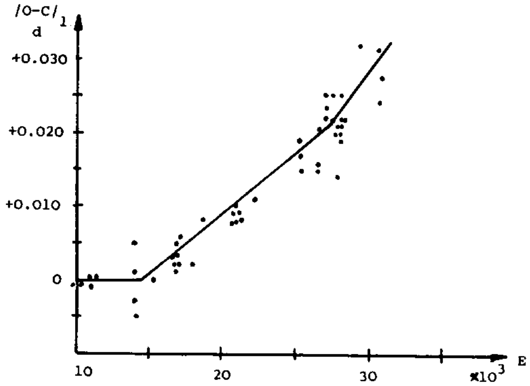


Figure 1

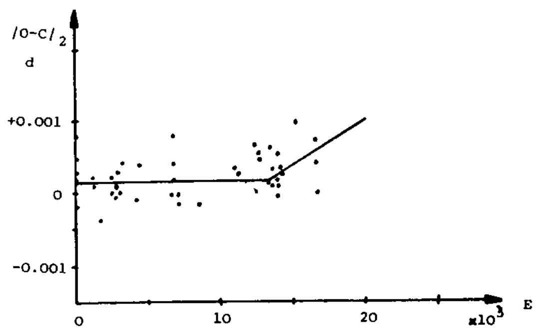


Figure 2

GABRIELA OPRESCU

MARIAN DORU SURAN

NEDELIA POPESCU

Astronomical Institute of Romanian Academy
7000 Bucharest, Cutitul de Argint 5

References:

Bergeat, J., Lunel, M., Garnier, R.: 1984, IBVS, No.2570.
Duerbeck, H.W.: 1975, IBVS, No.1023.
Duerbeck, H.W., Karimie, M.T., Hopp, U., Kiehl, M., Witzigmann, S.: 1978, IBVS, No.1497.
Dworak, T.Z., Oblak, E.: 1987, IBVS, No.2991.
Al-Naimiy, H.A., Fleyeh, H.A., Al-Sikab, A.O., Al-Razzaz, J.M.: 1986, IBVS, No.2956.
Hopp, U., Witzigmann, S.: 1982, Astrophys. Space Sci., 83, 171.
Mikolajewska, J., Mikolajewski, M.: 1980, IBVS, No.1812.
Oprescu, G., Suran, M.D., Popescu, N.: 1989, IBVS, No.3368.
Pohl, E., Tunca, Z.: 1985, IBVS, No.2793.
Rovithis, P.: 1981, Astrophys. Space Sci., 76, 351.
Rovithis, P., Rovithis-Livaniou, H.: 1989, IBVS, No.3339.
Scarfe, C.D., Forbes, D.W., Delaney, P.A., Gagne, J.: 1984, IBVS, No.2545.
Surkova: 1990, IBVS, No.3435.
Willmitch, T., Douglas, H.: 1989, IBVS, No.3318.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3561

Konkoly Observatory
Budapest
11 February 1991
HU ISSN 0374 - 0676

SPECTROSCOPIC OBSERVATIONS OF FIVE F SUPERGIANT STARS

We observed 5 F-supergiant stars, HD161796, 89 Her, IRAS 18095+2704, AFGL 2343 and HD 187885, with the high-dispersion coudé spectrograph (=5 Å mm^{-1}) of 74-inch telescope at the Okayama Astrophysical Observatory in August 1990. Our purpose was to detect Hα profiles implying mass losing phenomena. Sample objects are IRAS point sources, and occasionally show CO and/or OH radio molecular emission-lines (Likkel et al. 1987, Likkel 1989). We obtained several interesting observational results as the following:

(1) IRAS 18095+2704 and HD 187885 showed inverse P Cyg type profiles while 89 Her has a normal P Cyg type Hα line with a rather wide absorption component. The result on 89 Her seems to be quite identical to that of Luck et al. (1990).

(2) AFGL 2343 had a complicated Hα absorption-line profile consisting of several violet-shifted components.

(3) In addition to Hα, we could identify a couple of absorption-lines as FeI, FeII and CI which have suggested different radial velocities within our accuracy of velocity measurements, ± 6 km s^{-1}.

The features of line profiles are likely evidence for the mass losing process of these four stars.

It seems that a lot of F-supergiants show optical variability mentioned already on several samples. HD 161796 and 89 Her are well-known semi-regular variable stars, and the variability of IRAS 18095+2704 is also detected (Hrivnak et al., 1988). Optical variability often gives us important information on stellar masses and absolute magnitudes. It may be supposed that these stars would be less massive and of high luminosity, since the study of hydrodynamic models for the F-supergiants brighter than classical cepheids show that the variability will be irregular when the mass of models is less than a limit (Nakata, 1987; Aikawa, 1988; also Aikawa 1990). Thus the stars in our sample seem to be post AGB stars.

On the other hand, it is invoked that Sasselov (1984) proposed that some F-type semi-regular variable stars be classified as the UU Her stars, including HD 161796, 89 Her together with UU Her. Among them UU Her is not an IRAS point source, and found as a double-mode oscillator (Zsoldos and Jurcsik, 1989). The point-source IR radiation is evidence for mass-loss from the star. Both the lack of such an evidence and the success to decompose optical observations into two definite periods suggest us that UU Her is a massive star not a post-AGB star. Concerning HD 161796, we may imagine that the star stops mass ejection recently, and has sufficient circumstellar material supplied by past ejection.

It will be also interesting if we compare the complicated features of spectral lines with the optical variability. Photometric and spectroscopic monitoring of these stars will be useful in order to secure intrinsic characteristics of them.

S. TAMURA and M. TAKEUTI

Astronomical Institute, Tohoku University
Aoba-ku, Sendai 980 Japan

References:

Aikawa, T.: 1988, Ap. Space Sci., 149, 149.
Aikawa, T.: 1990, Ap. J., accepted.
Hrivnak, B.J., Kwok, S., Volk, K.M.: 1988, Ap. J., 331, 332.
Likkel, L.: 1989, Ap. J., 344, 350.
Likkel, L., Omont, A., Morris, M., Forveille, T.: 1987, A.A., 173, L11.
Luck, R.E., Bond, H.E., Lambert, D.L.: 1990, Ap. J., 357, 188.
Nakata, M.: 1987, Ap. Space Sci., 132, 337.
Sasselov, D.D.: 1984, Ap. Space Sci., 102, 161.
Zsoldos, E., Jurcsik, J.: 1989, IBVS, No.3295.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3562
Konkoly Observatory
Budapest
11 February 1991
HU ISSN 0374 - 0676

On the δ Scuti Period-Luminosity Relation

P-L relations for pulsating variables are of fundamental importance to astronomers. The existence of a tight correlation between a measurable parameter (period) and a relatively uncertain parameter (luminosity) is utilitarian as well as aesthetic. RR Lyr and Cepheid variables have been used to determine distances to globular clusters, the Galactic Centre, and Local Group members. The existence of δ Sct and the similar SX Phe variables in open clusters, globular clusters, and extragalactic systems then can provide independent estimates of distances to these systems.

The δ Sct pulsators seem to be more dynamically complex than other pulsators. This is manifested in P-L and P-L-C relations with relatively large dispersion which degrades their usefulness as potential distance indicators. Dworak & Zieba (1975) determined a P-L relation using 28 δ Sct stars with known parallax. They claimed that their stars fell into "two distinct groups" based on their absolute magnitude. The "bright" (or "ρ Puppis") and "faint" stars were distinguished based on absolute luminosity relative to a critical value of M_V=1. Leung (1970) and Eggen (1970) also made similar claims concerning two distinct luminosity groups though these were shown to be dubious by Breger (1979). The result of Dworak & Zieba's work was two P-L relations which, despite the division into brightness categories, showed considerable dispersion ($\sim$ 0.4 mag in V band).

Inclusion of a colour term reduces the dispersion in such relations for Cepheids. However, the observational P-L-C relation derived by Breger & Bregman (1975) still showed considerable uncertainty in M_V ($\pm$ 0.24 mag). An updated version by Breger (1979) had an estimated uncertainty of $\pm$ 0.31 mag in V band. Lopez de Coca *et al.* (1990, hereafter LRRG) used a large sample of δ Sct stars to derive a semi-empirical P-L-C relation. Though no formal estimate of the uncertainty is given, the dispersion of their Figure 1 appears to be $\sim$ 0.1 bolometric mag.

The above relations have not taken mode of pulsation into account. It is interesting to see what effect consideration of mode would have on a P-L

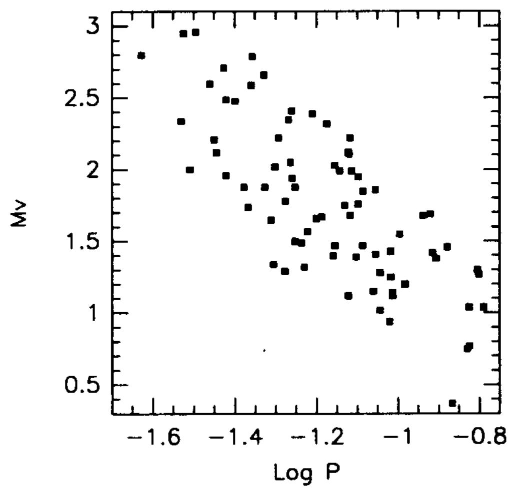


Figure 1

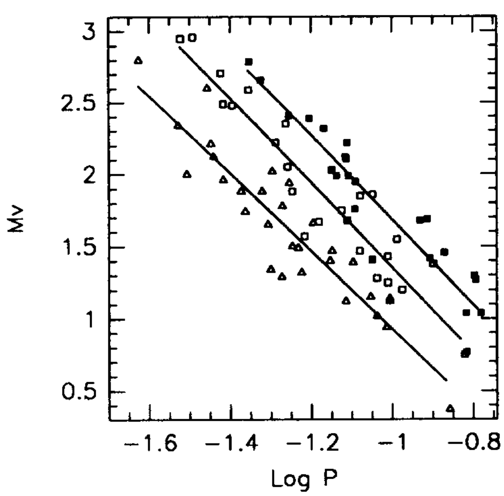


Figure 2

relation. In Figure 1, I have plotted M_V vs. Log P for the stars in LRRG's selected sample (their Table II). Clearly, there is a definite correlation, but the scatter is very large. In Figure 2, I have divided up the sample into fundamental mode pulsators (filled squares), first overtone pulsators (open squares), and second and third overtone pulsators (open triangles). The solid lines show least square fits to the three groups. The relations are given by the following formulae with rms dispersion (σ) and correlation coefficient (r) indicated:

Fundamental Mode: $M_V = -2.932 \times \log P - 1.247 (\sigma = \pm 0.036, r = 0.945)$

First Overtone: $M_V = -2.942 \times \log P - 1.588 (\sigma = \pm 0.038, r = 0.946)$

Second Overtone: $M_V = -2.698 \times \log P - 1.771 (\sigma = \pm 0.036, r = 0.924)$

At a given period, the higher order mode pulsators are brighter than lower order pulsators. Thus the division by Dworak and Zieba based on luminosity is somewhat unphysical. Rather, their separation reflects different modes of pulsation. The relations here show surprisingly small dispersion. However there are several caveats that one should be aware of: (1) The relation is only semi-empirical with M_v derived from $uvby\beta$ calibrations. (2) Some degree of circular reasoning has been invoked as for most of the points, LRRG derived a Q value from the relation given in Petersen and Jorgensen (1972). Here Q itself is dependent on M_V and log P in the same sense as in Figure 2 as well as the surface gravity, effective temperature, and appropriate bolometric corrections.

However, this semi-empirical relation provides a natural explanation for the effect seen by Dworak & Zieba. The relation also seems to indicate that the basic cycle count periods are meaningful; LRRG utilised a reduced period. Moreover, the relation should provide a framework for future work. After future, empirical calibration is undertaken, it seems that accurate luminosities could be determined with photometry in just one band if the photometry is such that it can give information on mode of pulsation. The inclusion of mode into the P-L relation has an analagous effect to including colour. Breger & Bregman found that for T_{eff}<7800 K, pulsation was in the fundamental mode while for hotter temperatures, the first overtone was prevalent. To investigate this, we again made use of the selected sample of LRRG. A t test reveals the difference in mean Q value between those stars hotter than 7800 K and cooler than 7800 K is significant at the 94% confidence level.

Future work should concentrate on calibrating such a relation. This will have to await more intensive ground base astrometry or the first results of the HIPPARCOS mission to provide trigonometric parallaxes. In addition, continued photometry may be required to provide reliable period estimates as well as empirical information on pulsational modes. In this way, recourse to theory is virtually eliminated. Additionally, it would be worthwhile to see if the SX Phe variables and dwarf Cepheids (if they are distinct from δ Sct variables) follow similar relations.

Jeremy R. King
Institute for Astronomy
2680 Woodlawn Drive
Honolulu, Hawai'i 96822

REFERENCES

Breger, M. 1979, Pub. Astron. Soc. Pacific, 91, 5

Breger, M. and Bregman J. N. 1975, Ap. J., 200, 343

Dworak, T. Z. and Zieba, S. 1975, IBVS, 1005

Eggen, O. J. 1970, Publ. Astron. Soc. Pacific, 82, 274

Leung, K. C. 1970, Astron. J., 75, 643

Lopez de Coca, P., Rolland, A., Rodriguez, E. and Garrido, R. 1990, Astron. Ap. Suppl., 83, 51

Petersen, J.O. and Jorgensen, H.E.: 1972, Astron. Astrophys., 17, 367.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3563

Konkoly Observatory
Budapest
14 February 1991
HU ISSN 0374 - 0676

THE LONG TERM BEHAVIOUR OF MWC 560

The emission line star MWC 560 was discovered by Merrill and Burwell (1943). It shows an interesting spectrum with P-Cygni profiles, widened Balmer absorption lines and an M-Type spectrum in the red region. In the ultraviolet the star shows a strong continuum. In the U-band flickering with an amplitude of ≈ 0.2 mag has been observed (Bond et al. 1984).

The observed properties led to the assumption that MWC 560 is a symbiotic-like object.

Although this star might be an interesting object, it has been forgotten by the astronomers in recent years. Early in 1990, MWC 560 attracted attention by remarkable rise in brightness. The star has been observed photoelectrically and spectroscopically by Tomov et al. since January 1990. The general rise in brightness is superimposed by rapid variations with an amplitude of some tenth of a magnitude. The spectrum also varies. Remarkable is the presence of strong blue shifted (up to -6000 km/h) Balmer lines with strongly varying profiles (Tomov et al. 1990a). Lack of observational data makes these phenomena difficult to explain.

I studied the photometric behaviour of MWC 560 on about 750 plates of the Sonneberg sky patrol covering the epoch from 1928 to the beginning of 1990 (see figure 1).

The star shows a Z And-like lightcurve with long time-scale variations of about 3 mag. There were two outbursts prior to J.D. ≈ 243 7000. Then the shape of the lightcurve changed. The brightness rose by about 2 mag during about 1000 days. The decrease to the quiet light came off much more slowly within about 4000 days. The process repeated itself, but with a short flash during decrease at J.D. ≈ 244 4000. Smaller variations of short period have occasionally been observed. This kind of variability was absent during the great outbursts in the past. Since J.D. ≈ 244 4750 the star rapidly gained in brightness and is now about 3 mag brighter than during its quiet stage.

Tomov et al. discussed a model of this star (Tomov et al. 1990b). They assume a symbiotic object consisting of an M-giant and a hot compact companion (e.g. a white dwarf). There is an accretion disk around it because of mass transfer from the giant to the hot star. This assumption is supported by the

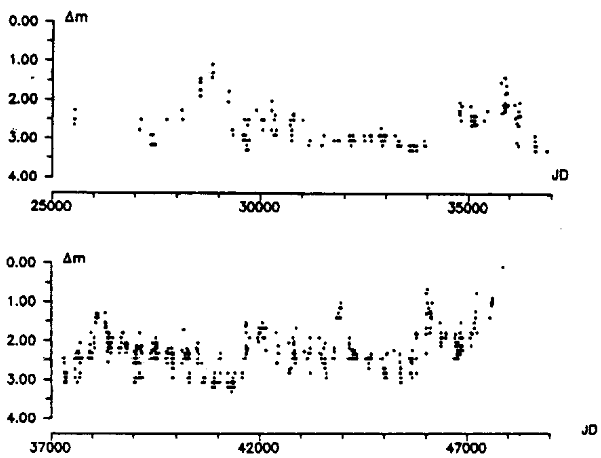


Figure 1 Photographic lightcurve of MWC 560

short-period variations in brightness with small amplitude. On account of the early constant radial velocities of the emission lines they assume that we see the disk "face on". In that case the accretion disk contributes most of the light, especially in the shorter wavelength range. Non-stable mass transfer from the M-giant might produce the long time-scale variations in brightness because of a variable accretion disk.

Without detailed spectroscopic and photometric studies it will be impossible to understand this interesting object.

R. LUTHARDT
Sonneberg Observatory
O-6400 Sonneberg/Thür.
Germany

References:

Bond, H.E., et al., 1984, B.A.A.S. **16**, 516

Merrill, P.W., Burwell, C.G., 1943, Astrophys. J. **98**, 153

Tomov, T., et al., 1990a, Nature **346**, 637

Tomov, T., et al., 1990b, "The puzzling star MWC 560", poster paper at the 12th Eureopean Regional Meeting, Oct. 1990, Davos, Switzerland

Tomov, T., 1990, private communication

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3564

Konkoly Observatory
Budapest
15 February 1991

HU ISSN 0374 - 0676

Light Curves for AB Doradus

AB Doradus (HD 36705) is a bright (V ~ 7.0), rapidly rotating (0.51^d), chromospherically active single star possessing a highly variable light curve (see Innis *et al.*, 1988). Only some of the Pleiades K dwarfs (Van Leeuwen and Alphenaar, 1982) rotate faster, and indeed the star's kinematical data and strong Lithium line (Rucinski, 1982) suggest that this is no coincidence with AB Doradus quite likely to be a member of the Local Association under going a late stage of Pre-Main Sequence contraction. It is widely accepted that the star's variability is due to large "star spots" which evolve rapidly, altering both the shape and amplitude of the light curve. Such a situation could be expected in such a rapidly rotating cool star, if the underlying magnetic field generation is essentially dynamo in nature (Weiss *et al.*, 1984).

Recently several light curves for AB Doradus have been analysed using a χ^2 minimisation Fortran program (see Banks and Budding, 1990, and Banks *et al.*, 1991, for details of the methodology) which demonstrated that two dark circular regions could adequately account for the differential light curve. A general background of maculation effects distributed uniformly in longitude was assumed to explain the variation in AB Dor's "immaculate" (unspotted) magnitude - which has progressively dimmed since the star's discovery in 1979 (Pakull, 1981). A range of inclinations was trialed by these two studies, in the hope that a better fit to the data would be obtained at one value, which might be near to AB Dor's real inclination. It was tentatively concluded that a low inclination around 65° might be preferred. This bulletin details a small continuation of these previous spot modelling efforts, analysing the February 1987 UBVRI light curves obtained by Cutispoto (1990) using the 50 cm ESO Cassegrain telescope.

Each waveband was modelled assuming two dark (i.e. 0 Kelvin) spots, Al-Naimiy's (1978) limb darkening coefficient appropriate for each passband, and a photospheric temperature of 5250 Kelvin (Allen, 1973) corresponding to Rucinski's (1985) spectral classification. The S/N ratio was arbitrarily assumed to be 100:1. Checking for indeterminacy using the Hessian matrix (see Budding and Najim, 1980) is an important part of our approach, preventing excessive over-parameterisation of the data (see also Banks and Budding, 1990a). Most of the fits (bar three) were determinate, indicating that the information content of the data was not being blatantly exceeded.A range of inclinations were trialed (90°, 80°, 70°, 60°, 50°) for each waveband, and their χ^2 values examined (see Table 1). Table 2 gives the "best fit" model parameters.

Parameters for the larger, second spot are more consistent between the wave bands, as could be expected as its greater photometric effect defines the values better. Observational noise in the few data points defining the first spot's effect has a considerable effect on its derived

Table 1: The values of χ^2 are plotted for each waveband and inclination trialed. Gaps are left when indeterminacy resulted. The actual numbers depend on the arbitrarily chosen observational error of 1%. An asterisk mark the best fit for each band.

Inclination	U Band	B band	V band	R band	I Band
90°	16.3	3.24	5.06	1.74 *	4.01
80°	15.3	2.86	5.38	1.85	3.63 *
70°	13.7	3.02	5.07	1.87	4.21
60°	13.6 *	2.57 *	4.79 *	-	-
50°	13.7	-	5.07	2.75	6.74

Table 2: The parameters for the best model fits from table 1 are given. All units are degrees. The number refers to the spot, i.e longitude 1 for the first spot's longitude.

Passband	longitude 1	latitude 1	radius 1	longitude 2	latitude 2	radius 2
U	69.2 ± 46.2	84.4 ± 0.6	30.2 ± 0.3	315.8 ± 16.5	55.6 ± 22.7	12.1 ± 7.2
B	82.8 ± 36.7	85.3 ± 2.6	30.1 ± 1.2	309.4 ± 30.1	44.8 ± 36.9	11.9 ± 2.5
V	88.9 ± 28.0	35.3 ± 4.3	17.8 ± 0.2	327.3 ± 1.3	46.2 ± 2.4	11.5 ± 0.2
R	38.0 ± 28.8	87.3 ± 3.0	30.1 ± 1.3	305.0 ± 14.0	62.9 ± 11.6	15.5 ± 1.8
I	34.5 ± 14.2	67.8 ± 5.0	15.9 ± 1.0	311.0 ± 22.2	58.7 ± 25.2	17.0 ± 3.5

parameters (see Figures 1 and 2) - particularly as the spot's effect overlaps considerably with the other spot's. Innis *et al.* (1988) asserted that while two spot groups were apparent on AB Dor during the period 1979 to 1987, they remained ≈ 180° apart in longitude, suggesting that the star might be an oblique-dipole rotator (see Stibbs, 1950). However the derived spots for February 1987 are closer to 120 degrees apart, as were those for January 1990 (Banks *et al.*, 1991). Further quantitative modelling of other light curves is required to resolve this issue. Budding and Zeilik (1987) noted that starspots appear to be located at relatively high latitudes, and that this is a feature of chromospherically active, short period stars. Support is lent to this conclusion. However the rather tentative suggestion that a low inclination might be preferred by AB Dor is not clearly supported by this study.

The spot temperature method outlined by Zeilik *et al.* (1989), based on the assumption that both the surrounding photosphere and the spot radiate as black bodies, was used on the R and I band data with the best V band model as the reference. Spot temperatures of 3860 ± 470 (I) and 3980 ± 40 (R) Kelvin were reached, in reasonable agreement with the values of 3840 ± 150 (I) and 3710 ± 230 (R) Kelvin that Banks and Budding (1990) derived for Lloyd Evans' (1987) 1984 data using the same method.

It is hoped that this small contribution will be of use to the many other investigators studying AB Dor. It is unfortunate that the only published light curves close in time to this one are

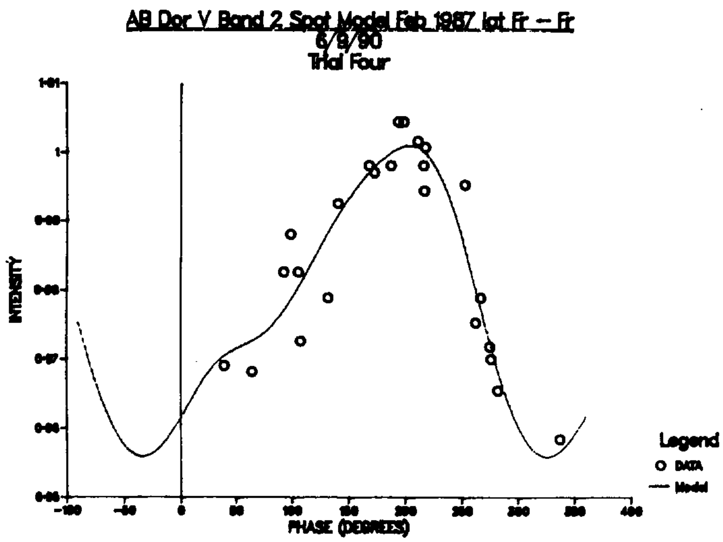


Figure 1 : The inclination 60° V band model fit (smooth line) is plotted against the data (rings).

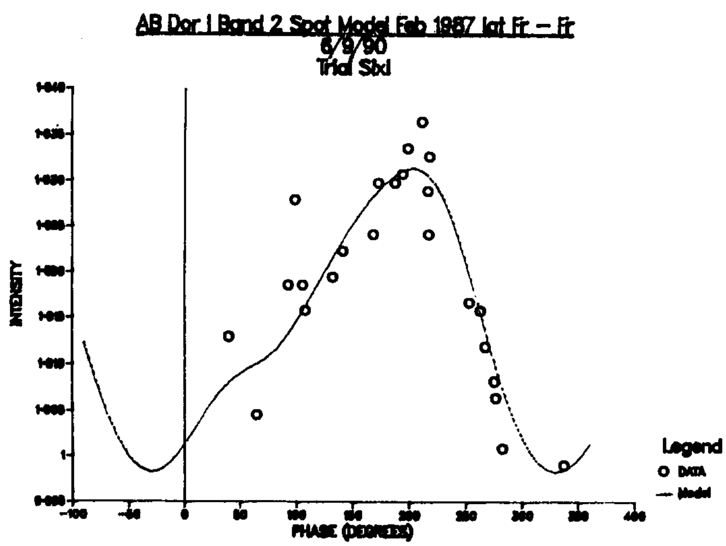


Figure 2: The inclination 80° I band model is plotted against that waveband's data.

the January 1987 and Sept/Nov 1986 curves of Innis *et al.* (1988), followed by December 1988 (Thompson and Thompson, 1989) and Anders' (1990) November 1989 data. Thus only general trends in AB Dor's spot evolution will be identifiable over this period, although modelling should still be worthwhile, particularly of the December 1988 data which is of high quality and complete phase coverage. However incomplete phase coverage and the low number of observational points inhibited the analysis of the Feb 1987 light curves, allowing observational errors to become overly influential. Many literature light curves also (see Innis *et al.*, 1988) exhibit these problems. To increase their information potential, future observations need to avoid these. Indeed, further observations are crucial, as AB Dor is a highly active star, and rightly deserves intensive scrutiny in the hope that a definitive spot evolution sequence can be obtained.

Timothy Banks

Physics Department,
Victoria University of Wellington,
P.O. Box 600, Wellington, New Zealand;
and Carter Observatory, P.O.Box 2909, Wgtn, N.Z.

References :

Allen, C.W., *Astrophysical Quantities*, Third Edition, University of London Press, London, 1973.
Al-Naimiy, H., 1978, *Astrophys. Spa. Sci.*, **53**, 181, 1978.
Anders, G., *IBVS # 3437*, 1990.
Banks, T., and Budding, E., *Astrophys. Spa. Sci.*, **167**, 221, 1990.
Banks, T., and Budding, E., *Earth, Moon, and Planets*, **49**, 15, 1990a.
Banks, T., Kilmartin, P.M., and Budding, E., accepted for *Astrophys. Spa. Sci.*, 1991.
Budding, E., and Najim, N.N., *Astrophys. Spa. Sci.*, **72**, 369, 1980.
Budding, E., and Zeilik, M., *Astrophys. J.*, **319**, 827, 1987.
Cutispoto, G., *Astron. Astrophys. Suppl. Series*, **84**, 397, 1990.
Innis, J.L., Thompson, K., Coates, D.W., and Lloyd-Evans, T., *Mon. Not. R. astr. Soc.*, **235**, 1411, 1988.
Lloyd-Evans, T., *South African Astron. Obs. Circ.*, **11**, 73, 1987.
Pakull, M.W., *Astron. Astrophys.*, **104**, 33, 1981.
Rucinski, S.M., 1982, *Astron. Astrophys. Suppl. Ser.*, **52**, 281, 1982.
Rucinski, S.M., *Mon. Not. R. astr. Soc.*, **215**, 591, 1985.
Stibbs, D.W.N., *Mon. Not. R. astr. Soc.*, **110**, 395, 1950.
Thompson, K., and Thompson, I., *IBVS 3320*, 1989.
Van Leuuwen, F., and Alphenaar, P., in *Activity in Red Dwarfs*, Eds : M.Rodono and P.D. Byrne, IAU Colloq **71**, 379, 1982.
Weiss, N.O., Cattaneo, F., and Jones, C.A., *Geophys. Astrophys. Fluid Dynamics*, **30**, 305, 1984.
Zeilik, M., Cox, D.A., De Blasi, C., Rhodes, M., and Budding, E., *Astrophys.J.*, **345**, 991, 1989.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3565

Konkoly Observatory
Budapest
20 February 1991
HU ISSN 0374 - 0676

ON SOME MISTAKES IN THE 4th EDITION OF THE GCVS

This paper appeared as a part of the results obtained when analyzing the publication "Accurate Positions for Variable and Suspected Variable Stars South of -67 Degrees" by López and Girard (1990). This article was kindly provided to us by its authors as a preprint; it contains accurate positions (1950.0) for 950 GCVS stars and 368 NSV starts and certainly is of considerable importance for the GCVS team because of the possibility to check co-ordinates for some stars entering the catalogues we publish.

Here I discuss three points of serious discrepancies with the GCVS or with the NSV catalogue.

1. The co-ordinates for CL Cha from the source in the literature were quoted in the GCVS incorrectly. They should be changed, in accordance with López and Girard, by -3^m in α.

2. Co-ordinates for several LMC and SMC stars corrected according to López and Girard will be included in the future Vol.5 of the GCVS comprising data for extragalactic variables.

3. Goossens *et al.* (1980) published a list of 22 Mira variables discovered by them in the constellation of Musca, presented for these stars finding charts and co-ordinates (1900.0). Later these stars obtained GCVS designations in the 65th Name-list of Variable Stars (Kholopov *et al.*, 1981). López and Girard present co-ordinates for 19 of these stars showing the positions given by the discoverers being wrong by $+0^m.655$ to $+2^m.130$ in α and by $-8'.000$ to $+51'.375$ in δ. We have checked each of these cases using charts of Vehrenberg's Atlas; we have also determined co-ordinates for three remaining stars not measured by López and Girard and again found large errors.

Great changes in adopted co-ordinates for all 22 stars lead to a number of mutual identifications of stars in the GCVS and the NSV catalogue. Two such cases of identity, FP Mus = CR Mus and FX Mus = DY Mus, have already been reported by López (1990). We find the following additional identifications (for the stars with finding charts available): GH Mus = YZ Mus, NSV 06119 = FV Mus, NSV 06122 = FW Mus, NSV 06274 = GG Mus, (and also NSV 04270 = = SV Vol, NSV 04934 = RY Cha - two more cases of identity, not from the paper by Goossens *et al.*).

In the cases of there being no finding chart for one of the stars of the pair, the following variables may be identical, according to their positional proximity and certain brightness characteristics: FN Mus = RX Mus?, NSV 05992 = FM Mus?, NSV 06049 = FS Mus?, NSV 06066 = FU Mus?, NSV 06289 = GI Mus?. All the stars with no finding charts were discovered by Luyten (1933). These suggestions of possible identifications need confirmation.

The rest of co-ordinate deviations between the results of López and Girard and the data in GCVS IV and NSV will be carefully checked and taken into account in future versions of our catalogues. The author team of the General Catalogue of Variable Stars wishes to thank C.E. López and T.M. Girard for their useful great activity and for their co-operation. My thanks are due to N.N. Samus for his assistance during the preparation of the manuscript.

E.V. KAZAROVETS

Institute of Astronomy
USSR Academy of Science

References:

Goossens, M., Stoop, C., Waelkens, C.: 1980, IBVS, No.1760.
Kholopov, P.N., Samus, N.N., Kukarkina, N.P., Medvedeva, G.I., Perova, N.B.: 1981, IBVS, No.1921.
López, C.E.: 1990, J. Am. Assoc. Var. Star Obs., 18, No.2 /in press/.
López, C.E., Girard, T.M.: 1990, PASP 102, No.655, 1018.
Luyten, W.J.: 1933, AN 249, 397.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3566

Konkoly Observatory
Budapest
20 February 1991

HU ISSN 0374 - 0676

ON TWO POSSIBLE GROUPS OF PULSATING BLUE STRAGGLERS WITH DIFFERENT MASSES IN GLOBULAR CLUSTERS

13 pulsating blue stragglers are now known in 4 globular clusters: ω Cen (3), M 3 (1), NGC 5466 (5), and NGC 5053 (4). Their periods ($0^d.031$ - $0^d.063$), $\langle V \rangle$, $\langle B \rangle$, $\langle B \rangle - \langle V \rangle$, light amplitudes ($0^m.08$ - $0^m.51$ V), M_V, and light curves (excluding ω Cen and M 3) are summarized by Nemec (1989). $\langle B \rangle - \langle V \rangle$ are unknown for NGC 5053.

We used globular cluster distance moduli system of Kukarkin (1974) with his values of [Fe/H] and E_{B-V} and model stellar atmosphere grid of Kurucz (1979) with input parameters log g = 4, [Fe/H] corresponding to each of the globular clusters studied, and $(B - V)_o = (\langle B \rangle - \langle V \rangle) - E_{B-V}$. In such a way we calculated for these pulsating blue stragglers their mean values of T_e, BC, M_V, M_{bol}, $(V - K)_o$, and M_K. These parameters are given in Table 1. Unfortunately for 4 pulsating blue stragglers in NGC 5053 we could calculate their mean M_V only; approximate values of mean M_K for them are based on the same conventional $V - K = 0^m.57$ (averaged value for 3 stars in ω Cen).

TABLE 1

	log P	M_V	$(V-K)_o$	M_K	M_{bol}	log T_e
ω CEN						
NJL220	−1.328	+3.23	0.49	+2.74	+3.16	3.894
E39	−1.252	+3.22	0.57	+2.65	+3.16	3.884
NJL79	−1.201	+2.98	0.64	+2.34	+2.92	3.875
M 3	−1.51	+3.51	0.70	+2.81	+3.45	3.868
NGC 5466						
NH29	−1.398	+3.10	0.66	+2.44	+3.02	3.874
Anon.1	−1.342	+3.49	0.48	+3.01	+3.42	3.897
NH35	−1.298	+3.13	0.97	+2.16	+3.01	3.838
NH27	−1.292	+3.01	0.70	+2.31	+2.93	3.870
NH38	−1.268	+2.96	0.86	+2.10	+2.86	3.850
NGC 5053						
NC7	−1.460	+3.45	(0.57)	+2.88		
NC11	−1.447	+3.80	(0.57)	+3.23		
NC13	−1.433	+3.66	(0.57)	+3.09		
NC14	−1.421	+3.67	(0.57)	+3.10		

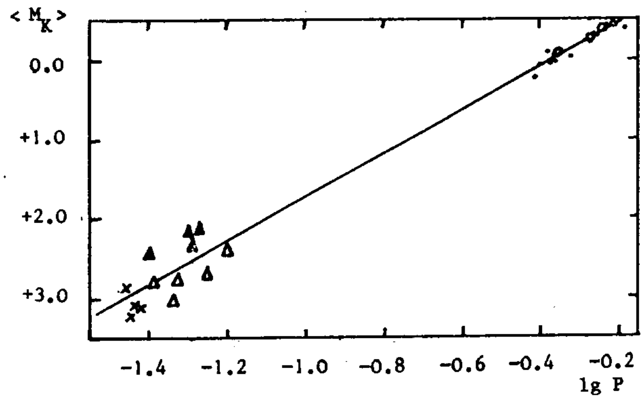


Figure 1 The P-L relation for RR Lyrae stars: $\langle M_K \rangle = -2.72 \log P - 0.99$. Besides field RR Lyraes (dots) and 4 RR Lyraes in M 4 (open circles), pulsating blue stragglers are also plotted: open triangles, crosses, and filled triangles (most massive stars).

Liu and Janes (1990a) on the base of a modern version of the Baade - Wesselink technique derived a very accurate period - luminosity relation in the K band (2.2 μm) for 13 field RR Lyrae stars with very different metallicities [Fe/H] from 0.0 to -2.20. They confirmed (once more) that even extremely different metallicities have no influence on M_K values. Therefore deviations from the straight line of the $\langle M_K \rangle$ - log P relation must be connected with deviations from the mean mass (0.5 - 0.6 solar masses) of RR Lyrae stars. Hence it would be interesting to investigate positions of pulsating blue stragglers on this relation.

Fig. 1 shows that in the first approximation the relation $\langle M_K \rangle$ - log P for RR Lyrae stars (dots and open circles) is also valid for the pulsating blue stragglers in globular clusters (triangles and crosses). 13 field RR Lyrae stars (dots) are plotted according to the data of Liu and Janes (1990a). 4 additional RR Lyrae stars from the globular cluster M 4 (open circles) are plotted according to Liu and Janes (1990b); their $\langle M_K \rangle$'s were derived by these authors in the same way as for field RR Lyrae stars. The data for pulsating blue stragglers are taken from Table 1. The star in M 3 is plotted with the modified period value corresponding to fundamental pulsation (due to its sinusoidal light curve and small amplitude this star should be considered as pulsating in the mode 1H). Crosses denote provisional $\langle M_K \rangle$ values for 4 stars in NGC 5053.

Now let us try to estimate the masses of the pulsating blue stragglers in NGC 5466, M 3, and ω Cen. We used the same differential method that had been earlier used by Jorgensen and Hansen (1984) in their determination of masses of 3 blue stragglers in ω Cen comparing them with RR Lyrae stars. We consider it much better to compare pulsating blue stragglers not with RR Lyrae stars, which are giants, but with the δ Sct stars in open clusters (reliable luminosities, similar periods) which are also dwarf stars with the same log g = 4 as in the case of SX Phe stars.

We used as "comparison stars" two δ Sct variables on the main sequence of the Praesepe cluster: BX Cnc = KW 445 and BY Cnc = = KW 449. Their parameters are: $P = 0^{d}.053$ and $0^{d}.058$, $M_V = +1.77$ and +1.82, $(B - V)_0 = 0.201$ and 0.208, correspondingly (Frolov, Irkaev, 1984, with slightly corrected M_V's).

Both known data sources on the pulsation mode discrimination for the δ Sct stars (Breger, Bregman, 1975; Tsvetkov, 1985) give for BX Cnc and for BY Cnc the same mode 1H. These stars are also not known as binaries of any sort. From the grid of Kurucz's models of stellar atmospheres with the input parameters [Fe/H] = = 0, log g = 4 we calculated from $(B - V)_0$ for BX Cnc and BY Cnc the needed values of T_e, BC, $(V - K)_0$, and after that also M_{bol} and M_K. According to modern evolutionary tracks, the masses of BX Cnc and BY Cnc are equal to 1.8 solar masses. Further we used the equation (Jørgensen, Hansen, 1984)

$$\log (\mathfrak{M}_{bs}/\mathfrak{M}_{\delta\ Sct}) = 2\Delta\log Q - 2\Delta\log P - 0.6\Delta M_{bol} - 6\Delta\log T_e,$$

where $\mathfrak{M}_{bs}$ is the blue straggler mass, $\mathfrak{M}_{\delta Sct}$ is the δ Scuti star mass, $\Delta\log Q = \log Q(\text{blue str.}) - \log Q(\delta\ \text{Sct})$, *etc*. So we could estimate the masses of the pulsating blue stragglers, assuming the fundamental pulsation for all them in ω Cen and in NGC 5466, but the 1H mode in the case of the star in M 3. Our mass estimates, separately from comparisons with BX Cnc and with BY Cnc, are presented in Table 2.

The pulsating blue stragglers in NGC 5466 NH29, 35, and 38 in Fig. 1 (filled triangles) have the highest deviations upward from the P-L line and have the highest masses. These 3 stars, maybe together with NH27, have masses in accordance with those expected from the hypothesis of coalesced binaries (see Nemec, 1989). Another group of pulsating blue stragglers placed on or downward

TABLE 2

	$\mathfrak{M}_{bs}$(BX)	$\mathfrak{M}_{bs}$(BY)	$\langle\mathfrak{M}_{bs}\rangle$
	solar masses		
ω CEN			
E39	0.48	0.56	0.5
NJL220	0.59	0.69	0.6
NJL79	0.60	0.70	0.6
M 3	0.76	0.88	0.8
NGC 5466			
NH27	0.97	1.11	1.0
NH29	1.30	1.52	1.4
NH35	1.37	1.60	1.5
NH38	1.25	1.45	1.4
Anon.1	0.42	0.49	0.5

of the P-L line have masses comparable (maybe excluding the star in M 3) with RR Lyrae masses (0.47 - 0.62 solar masses; *cf.* Liu and Janes, 1990a). So the second group can be preliminary considered as ultra-short-period RR Lyrae stars.

It is interesting to note that the 3 most massive stars in NGC 5466 (NH38, 29, and 35) have distances from the cluster center 0.7' - 0.9'. The slightly less massive NH27 has a slightly greater distance, 1.4'. Unfortunately we do not know the distance of Anon.1 in the same globular cluster, which is a much less massive object. Also, the most distant star E39 in ω Cen (18') has the smallest mass among the 3 known pulsating blue stragglers in this cluster. This may be considered as an independent ("dynamical") confirmation of the reality of the groups of pulsating blue stragglers in globular clusters having a strong difference in their masses.

M. S. FROLOV

Institute of Astronomy
USSR Academy of Science

References:

Breger, M., Bregman, J.N.: 1975, Astrophys. J. 200, 343.
Frolov, M.S., Irkaev, B.N.: 1984, IBVS, No.2504.
Jørgensen, H.E., Hansen, L.: 1984, Astron. Astrophys. 133, 165.
Kukarkin, B.V.: 1974, "Globular Star Clusters" (Moscow:Nauka), (in Russian).
Kurucz, R.L.: 1979, Dudley Observatory Rept. No.14.
Liu, T., Janes, K.A.: 1990a, Astrophys. J. 354, 273.
Liu, T., Janes, K.A.: 1990b, Astrophys. J. 360, 561.
Nemec, J.M.: 1989, "The Use of Pulsating Stars in Fundamental Problems of Astronomy" (IAU Coll. 111, ed. E.G. Schmidt), p.215.
Tsvetkov, Ts.G.: 1985, Astrophys. Space Sci. 117, 137.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3567
Konkoly Observatory
Budapest
25 February 1991
HU ISSN 0374 - 0676

FLICKERING IN CATACLYSMIC VARIABLES WITH BRIGHT ACCRETION DISKS *

The phenomenon of flickering is a feature common to all catalysmic variables (CVs). However, it has not won much attention so far. The only attempt to systematically study its properties has recently been undertaken by Bruch (1989)[1]. In an effort to enlarge the statistical base for such investigations it was attempted to obtain flickering light curves of several more CVs. For that purpose a number of objects which are supposed to have accretion disks in a bright state, i.e. classical novae in quiescence and UX UMa type novalike variables, were selected. Due to unfavourable weather conditions only three of them could finally be observed. These are V603 Aql, QU Car and RW Sex.

The observations took place on 1988, April 10 and 11 at the 60–cm–telescope of the Observatório Astrofísico Brasileiro on Pico dos Diaz, Brasopolis, Brazil. A one–channel Texas photometer was used to take sequential measurements in the passbands of the UBV system with integration times of 5^s per channel. Several standard stars selected from the list of Landolt (1973) were observed each night in order to enable a determination of the extinction and a transformation of the observations into the standard system. The data were reduced with the MIRA software system (Bruch 1987) at the Astronomisches Institut Münster.

Intermittent fog forced frequent interruptions of the observations. Therefore, the individual light curves of the observed CVs are all of rather short duration. Mean magnitudes and colours together with their errors calculated from the individual light curves are collected in Tab. 1. Note that the quoted mean errors are not dominantly caused by noise in the data but by the real variations due to the flickering of the systems.

Table 1: Journal of observations

Name	Date 1988 April	Obs.-time UT start	end	Number of integr.	V	$B-V$	$U-B$
V603 Aql	10	5:18	6:20	215	11.92±0.04	−0.06±0.03	−1.05±0.03
QU Car	10	4:10	4:55	162	11.23±0.04	−0.05±0.02	−1.06±0.02
QU Car	11	0:23	1:21	128	11.32±0.04	−0.04±0.02	−1.01±0.02
RW Sex	10	1:18	2:44	293	10.70±0.01	−0.07±0.01	−0.87±0.01

The B band light curves of the observed stars are shown in Fig. 1. All of them reveal the flickering activity typical for CVs. However, there are strong dif-

*based on observations made at the Laboratório Nacional de Astrofísica – LNA/CNPq, Brazil

[1]Copies of this study (in English) are available in a limited number from the author. A condensed version will be published elsewhere.

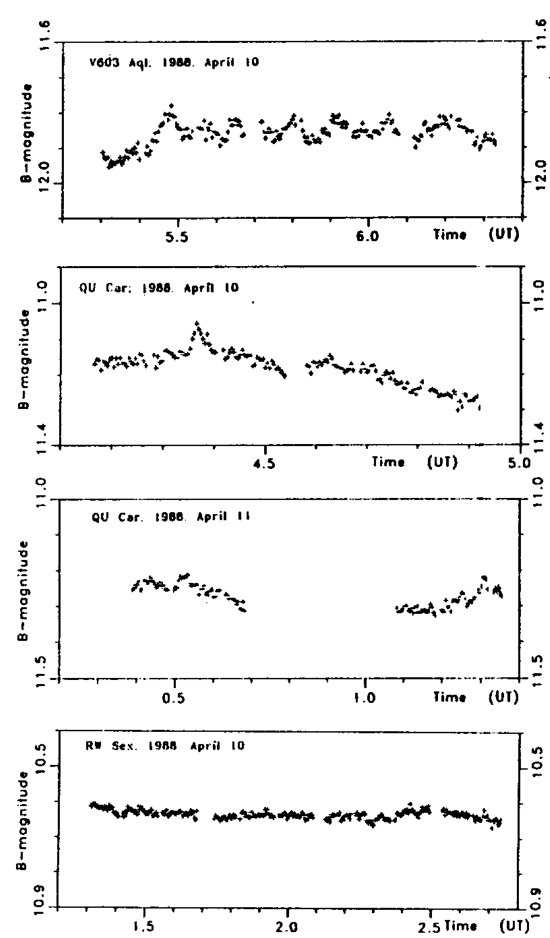


Figure 1 B band light curves of the observed stars

ferences concerning the total amplitude and the activity. The strongest flickering is observed in V603 Aql, while RW Sex shows only slight, albeit significant variations. The flickering in the light curves of V603 Aql and QU Car on April 10 was subjected to a quantitative analysis using techniques developed by Bruch (1989) to which the reader is referred for details. The two sections of the light curve of QU Car of April 11 being too short, and the amplitude of the variations of RW Sex being too small, such an investigation of the flickering was not possible in these cases. The results are summarized in Tab. 2 which contains the following information:

Table 2: Properties of the flickering in V603 Aql and QU Car

	V603 Aql 1988, April 10	QU Car 1988, April 10		unit
$E_{(B-V)}$	0.07	0.16	0.0	mag
number of flares	7	3	3	–
limiting amplitude	0.03	0.02	0.02	mag
total amplitude	0.18	0.25	0.25	mag
flare rate	7.3	4.0	4.0	hour^{-1}
gradient ratio	0.77 ±0.50	2.00 ±1.98	2.00 ±1.98	–
activity a(m)	0.018	0.011	0.011	mag/min
activity $a(F)$	2.82×10^{-15}	4.55×10^{-15}	2.43×10^{-15}	[erg/(sec cm^2 μ)] /min
$F(V)/F(B)$	0.66 ±0.06	0.38 ±0.03	0.56 ±0.06	–
$F(U)/F(B)$	2.48 ±0.31	1.79 ±0.18	1.64 ±0.17	–

1. the interstellar reddening. Some of the properties listed below are distorted by interstellar extinction. These are the activity expressed in flux units and the flux ratios in various bands. To obtain physically meaningful results for these quantities an extinction correction is required. For V603 Aql a colour excess of $E_{(B-V)} = 0.07 \pm 0.01$ was derived as a mean value from five independent measurements (see Bruch 1989). For QU Car a value of $E_{(B-V)}$ = 0.16 was determined by Schild (1969). However, this value – being based on doubtful assumptions – is highly uncertain. Therefore, Tab. 2 contains also results calculated under assuming zero extinction.

2. the total number of individually resolved flares in the flickering upon which the results are based.

3. the limiting magnitude for the flares. Flares with a smaller total amplitude cannot confidently be separated from noise and are therefore not considered.

4. the total amplitude of the variations in the light curve defined as the difference between the faintest and the brightest data points.

5. the flare rate defined as the number of individually resolved flares per time unit.

6. a symmetry parameter defined as the mean ratio of the mean gradients of the rising and declining branches of individual flares. A value <1 indicates a slower rise than decline, a value >1 means that the rise is steeper than the decline.

7. the activity defined as the sum of the absolute values of all brightness variations in flares per time unit on the magnitude scale.

8. the activity as above, but expressed in flux units. The calibration of Hayes (1979) has been used to transform magnitudes into fluxes.

9. the mean flux of the flickering light source (i.e. in the flares) in the V band relative to that in the B band.

10. the mean flux ratio of the flickering light source in the U band relative to that in the B band. Together with the previous item this defines the broad band spectrum of the flickering light source at the locations of the isophote wavelengths in the UBV system, normalized to the B band.

Except for the flux ratios the numerical values in Tab. 2 refer to the B band of the considered light curves. It will not be attempted here to interpret the properties of the flickering in the investigated systems. To do so meaningfully a larger sample of flickering light curves is required. Therefore, the present results may serve as input data for future, more encompassing studies of the flickering.

ALBERT BRUCH

Dr.–Remeis–Sternwarte
Sternwartstraße 7
8600 Bamberg
Fed. Rep. Germany

and

Astronomisches Institut
Wilhelm–Klemm–Straße 10
4400 Münster
Fed. Rep. Germany

References

Bruch, A.: 1987, in: D. Teuber (ed.): *Astronomical Data Analysis system*, AIM, Münster
Bruch, A.: 1989, *Eigenschaften und Ursachen des Flickering in kataklysmischen Veränderlichen*, habilitation thesis, Münster
Hayes, D.S.: 1979, in: A.G. Davis Philip (ed.): *Problems of Calibration of Multicolour Photometric Systems*, Dudley Obs. Report No. 14, p. 297
Landolt, A.U.: 1973, *Astron. J.* **78**, 959
Schild, R.E.: 1969, *Astrophys. J.* **157**, 709

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3568

Konkoly Observatory
Budapest
1 March 1991

HU ISSN 0374 - 0676

Nature of the variability of VV Scl

HD 7676 is an Ap star, the spectral type of which is A5 SrCrEu (Renson *et al.* 1991). Its light variability found by Cousins and Stoy (1962) has been studied by Strohmeier (1965), who derived a period of 2.47962 days, with a double-wave variation curve considered to be due to eclipses. Accordingly HD 7676 received the variable-star name VV Scl.

But we believe that it is unduly classified as an eclipsing variable.

With a period as large as 2.48 days, an A5 eclipsing star would most probably be of the Algol type. But the figure on the fifth page of Strohmeier's paper shows that the maxima of VV Scl are not flat at all, and that the variation is smooth and continuous, the minima being not deep. The latter are only somewhat sharper than the maxima.

The error of the measurements is not quoted, but from the dispersion of the points it can be inferred that it is relatively large. It is even not quite sure that the variation is double-waved; it may be that the real period is only 1.24 day instead of 2.48. According to Strohmeier's figure, the B values at the primary and the secondary minima are perhaps 8.73 and about 8.70 respectively, while at the maxima they are about 8.56 and 8.59. Thus the difference between the minima is not larger than the difference between the maxima, and it remains within the limits of the errors.

Even if the double wave is real, it remains most probable that the variations of VV Scl are of the αCVn type and not due to eclipses, since many Ap stars exhibit double-wave variations.

The main argument against the hypothesis of an eclipsing or an ellipsoidal variable lies in the fact that V does not vary similarly to B. According to the table in Strohmeier's paper, V remains almost constant within the limits of error. The mean value is 8.39, and the extreme values in that table are 8.35 and 8.43. Such differences for the behaviour in various colours are typical of Ap-star variations.

If VV Scl were an eclipsing variable, the observed variation should be considered as being small, implying very partial eclipses. On the contrary the range in B is very large if the variation is only of the αCVn type. The difference between the values quoted above for the higher maximum and the lower minimum in B is 0.17. This range is among the largest known for Ap stars. Thus it would be very interesting to have accurate measurements of this star in the Strömgren system for instance. Moreover it is to be hoped that they will enable to confirm that the variations do not originate from eclipses. Such measures are now already planned at the European Southern Observatory (ESO).

P. RENSON
Institut d'Astrophysique
Université de Liège
Avenue de Cointe, 5
B-4000 Liège (Belgium)

References

Cousins, A.W.J., Stoy, R.H., 1962, *Roy.Obs.Bull.* **64**
Renson, P., Gerbaldi, M., Catalano, F.A., 1991, *Astron.Astrophys.Suppl.*, in press
Strohmeier, W., 1965, *Inform.Bull.Var.Stars* **89**

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3569

Konkoly Observatory
Budapest
7 March 1991

HU ISSN 0374 - 0676

RECENT MINIMA AND IMPROVED EPHEMERIDES FOR THE ECLIPSING HOT SUBDWARFS LB3459 (=AA DOR) AND BD-7° 3477 (=HW VIR)

The hot sdOB star LB 3459 (=AA Dor) was discovered to be an eclipsing binary by Kilkenny et al (1978) and has a rather short period of 6^h17^m. The parameters of the secondary star are not well known but it appears to be close to a degenerate configuration (Kudritzki et al 1982) and most of the visible light from the secondary is apparently reflected primary light. The sdB star BD-7° 3477 (=HW Vir) was discovered to be an eclipsing binary by Menzies & Marang (1986) during a survey of UV-bright objects. It has a very short period (2^h48^m) and the secondary could be a red main-sequence star (Menzies & Marang 1986).

Because of the evolved nature of the primary stars in these systems and the short periods, it seems highly likely that both could have passed through at least one "common envelope" stage (Paczynski 1980). Currently, both binaries appear to be detached so that mass exchange by Roche lobe overflow is not likely to be occurring. Angular momentum loss by gravitational radiation or by mass loss via stellar winds would affect the periods; the former should only be measurable after $\sim10^2$-10^3 years (see, e.g. Paczynski 1967) but the latter might be more effective. We have therefore made occasional observations of eclipses of both systems with a view to establishing very accurate ephemerides to test for period changes.

The most recent ephemerides for AA Dor and HW Vir have been given by Kilkenny (1986) and Marang & Kilkenny (1989) respectively. The new timings of primary minima together with estimated errors are listed in Table 1, where the cycle numbers ,n, are determined from the above mentioned ephemerides. All observations were made with the 1.0m and 0.5m telescopes at the Sutherland site of the South African Astronomical Observatory. Various filters were used (see Table 1) with 20- or 30-second continuous integrations to obtain the eclipse curves. Sky measures were made before and after eclipse and usually near mid-eclipse; the sky corrections were then interpolated for all eclipse data.

The results for HW Vir are more accurate than those for AA Dor, probably due to the fact that HW Vir is rather brighter than AA Dor and that the latter is a foreground LMC object which means a smaller aperture is necessary and so scintillation and guiding effects are more serious.

Combining the new eclipse timings with published results, we obtain for HW Vir:

$$T_{min} = 244\ 5730.556071 + 0.1167196336n$$
$$\pm 0.000014 \quad \pm 0.0000000017$$

from 34 eclipses. T_{min} is the time of primary mid-eclipse and the errors are formal errors from a linear least-squares fit to the times of mid-eclipse.

For AA Dor we obtain

$$T_{min} = 244\ 3196.348685 + 0.2615397198n$$
$$\pm 0.000016 \quad \pm 0.0000000017$$

from 27 eclipses. The eight timings between cycles 1000 and 4000 are excluded from the linear least squares solution because these were either multicolour (uvby) and therefore of much poorer time resolution or were of poor quality. Including these data in the solution makes almost no difference to the ephemeris coefficients but does make the errors significantly worse.

TABLE 1 New timings of primary minima

	HJD		Est.error	n	Filter	Tel
AA Dor	2446795.39692	±	0.00005	13761	V	1.0m
(=LB3459)	6801.41230		0.00005	13784	V	1.0
	7121.53695		0.00010	15008	y	1.0
	7850.44822		0.00005	17795	V	1.0
	8267.34250		0.00003	19389	V	1.0
HW Vir	2447968.53836	±	0.00002	19174	B	0.5m
(=BD-7° 3477)	7972.50682		0.00002	19208	B	1.0
	8267.57410		0.00002	21736	V	1.0

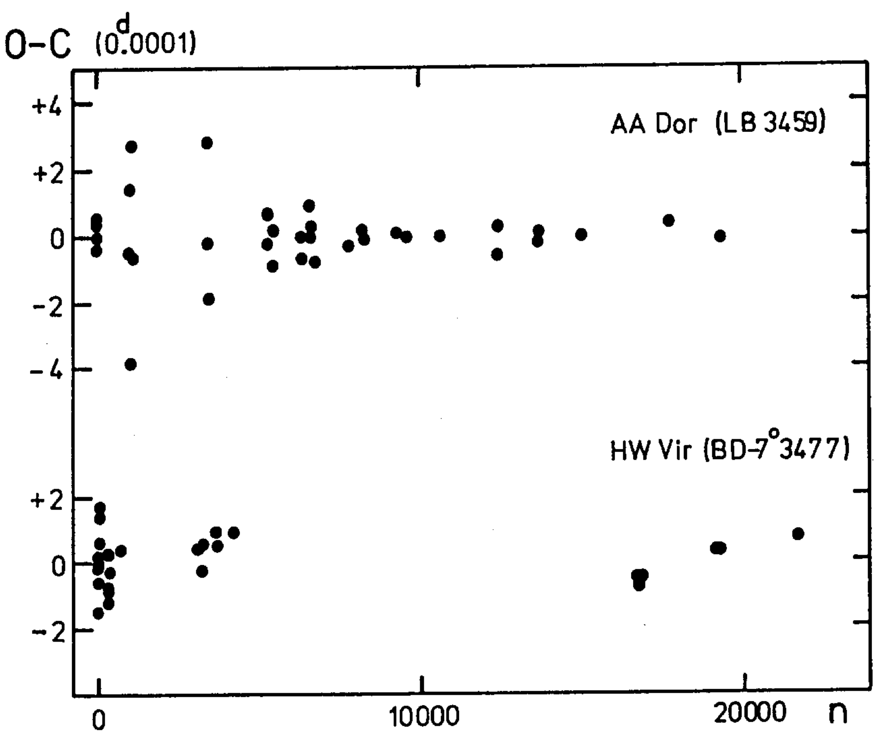


Fig. 1. (O-C) diagrams for AA Dor and HW Vir based on the ephemerides determined in this paper. The AA Dor data were obtained between 1977 and 1991; the HW Vir data between 1984 and 1991.

Figure 1 shows the (O-C) residuals for both binaries. In the case of AA Dor, the linear fit is very good and there is no evidence for period change. For HW Vir there is a weak indication in the most recent data that the linear fit may not be good enough.

It is unfortunate that no observations of HW Vir were made during 1986-1989 and it is clear that further data are very desirable.

D. KILKENNY, M. HARROP-ALLIN, F. MARANG
South African Astronomical Observatory
P O Box 9, Observatory 7935, S. Africa

References:

Kilkenny, D., Hilditch, R.W. & Penfold, J.E., 1978. Mon. Not. R. astr. Soc., **183**, 523.

Kilkenny, D., 1986. Observatory 106, 160.

Kudritzki, R.P., Simon, K.P., Lynas-Gray, A.E., Kilkenny, D. & Hill, P.W., 1982. Astr. Astrophys., **106**, 254.

Marang, F. & Kilkenny, D., 1989. Inf. Bull. Var. Star, 3390.

Menzies, J.W. & Marang, F., 1986. IAU Symposium 118, 305.

Paczynski, B., 1967. Acta. Astr., **17**, 287.

Paczynski, B., 1980. Acta. Astr., **30**, 113.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3570

Konkoly Observatory
Budapest
8 March 1991

HU ISSN 0374 - 0676

1988 AND 1989 PHOTOMETRY OF UZ LIBRAE

UZ Librae (= #102 in the catalog of Strassmeier et al. 1988) is most likely an FK Comae star with a 4.75 day rotational period and a low mass companion. Bopp et al. (1984) report 1983 photometry and spectroscopy. Grewing et al. (1989) deduce the properties of individual components of the UZ Lib system from spectroscopic and photometric data and update both the photometric and orbital periods.

We present UBV photometry of UZ Lib from May 1988 and May through July 1989. We used the 24" telescope operated by San Diego State University at Mt. Laguna, CA. Our comparison and check stars are BD -07°4044 and BD -08° 3998. The data are in the Johnson UBV system and in the sense star - comp. We computed the orbital phase using ϕ=2445428.88 +4.767885E after Grewing et al. (1989).

The ΔV light curves (see Figures 1 and 2) for both years have a double peaked structure, indicating the existence of two starspot groups. The starspot group at phase 0.2 appears to be the larger because the minimum on the light curve is deeper. The ΔV light curves show an amplitude of variability of about 0.2 magnitudes in 1988 and 0.3 magnitudes in 1989. The minimum light at phase 0.2 is fainter in 1989 than in 1988; therefore, that spot group grew between 1988 and 1989. In addition, the fainter maximum light in 1988 indicates that the starspots were distributed more evenly over the surface of the star in 1988 than in 1989. The large amplitude of variability combined with the changes from 1988 to 1989 suggest that UZ Lib has a high level of chromospheric activity and changes rapidly.

The double peaked light curves are similar to the double peaked curves seen

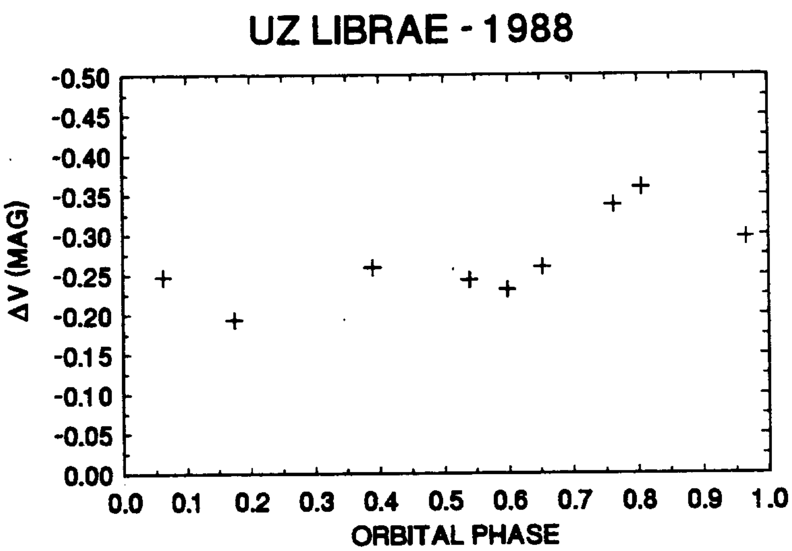


FIGURE 1

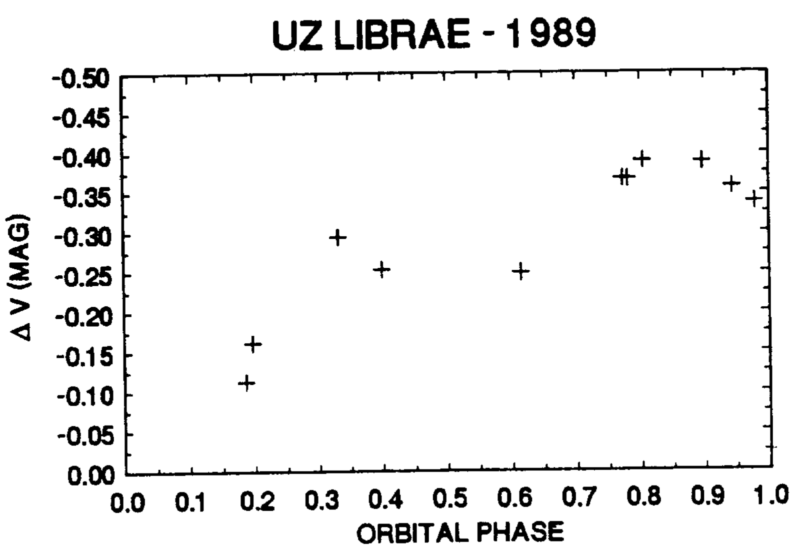


FIGURE 2

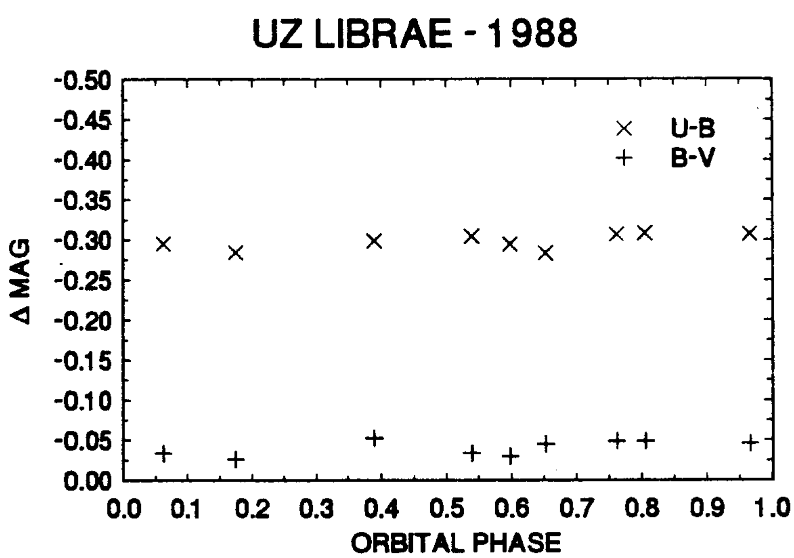


FIGURE 3

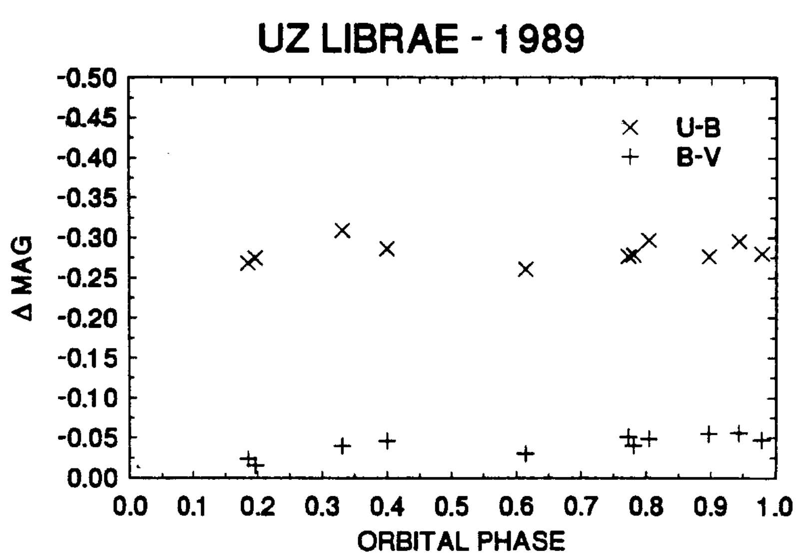


FIGURE 4

for the particularly active chromosphere star, BD+61°1211 during 1981 and 1982. For BD+61°1211, these double peaked curves represent a transition period when one spot group was breaking up and a new spot group was forming (Heckert 1990). Continued annual light curves will tell us if these double peaked light curves in UZ Librae also represent the transition period between two spot groups.

Little color change is seen in either ΔU-B or in ΔB-V (See Figures 3 and 4). While the changes are small and therefore difficult to interpret, both indices show UZ Lib becoming more red during minimum light as one would expect if cooler starspots cause the photometric variations.

Ron Angione scheduled very generous amounts of time on the Mt. Laguna 24" telescope for this work. Western Carolina University provided travel funds for PAH through a faculty research grant and additional funds. MAH received travel support from Sigma Xi. The Research Corporation also provided partial support for the writing of this paper.

PAUL A. HECKERT
Western Carolina University
Cullowhee, NC 28723
USA

MARY ANN HICKMAN
Agnes Scott College
Decatur, GA 30030
USA

REFERENCES

Bopp, B. W., Goodrich, B. D., Africano, J. L., Noah, P. V., Meredith, R. J. Palmer, L.H., and Quigley, R. J., 1984, Astrophys. J., 285, 202.

Grewing, M., Bianchi, L., and Garrido, R., 1989, Astron. and Astrophys., 223, 172

Heckert. P.A., 1990, Inf. Bull. on Var. Stars, no.3446.

Strassmeier, K. G., Hall, D. S., Zeilik, M., Nelson, E. Eker, Z., and Fekel, F. C., 1988, Astron. and Astrophys. Suppl. Ser., 72, 291

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3571

Konkoly Observatory
Budapest
8 March 1991
HU ISSN 0374 - 0676

WR 22 is an eclipsing binary star

Introduction

WR 22 ($\equiv$ HD 92740 $\equiv$ V429 Car) is a bright ($V \sim 6.4$) Wolf-Rayet star of spectral type WN7, member of the Car OB1 association (Lundström and Stenholm, 1984). For a long time, it has been known to exhibit a composite spectrum (Smith, 1955; Underhill, 1968) in the sense that weak absorption lines (e.g. Balmer series from H7 up to H12) are observed in a spectrum that is otherwise characterized by typical strong Wolf-Rayet emission lines. These characteristics which are usually suggestive of binarity, were the motivation for Niemela (1973) to undertake a radial velocity study. Her preliminary study confirmed the binary nature of WR 22 but the absorption and emission lines were found to move in phase, indicating that they are formed in the same object. Subsequent spectroscopic investigations (Niemela, 1979; Moffat and Seggewiss, 1978; Conti, Niemela and Walborn, 1979) led to a revision of the period and to a rather well-determined set of orbital parameters: let us just mention a period of 80.35 days, a high eccentricity $e \sim 0.55$ and a longitude of the periastron ω of roughly 275°. Up to now, no marked trace of the secondary star was found, and the star is therefore classified as an SB1.

WR 22, as most Wolf-Rayet stars, is photometrically variable. On JD 2,447,235.5, during a campaign on the intrinsic variability of several WR stars, Balona et al. (1989a, b) observed a dip in the lightcurve of WR 22 of about 0.1 mag in the Johnson B filter. The fading was interpreted as the signature of an eclipse. It lasted roughly one day, or less, and corresponded to the Wolf-Rayet hiding the secondary star. As the star is known to vary on a short timescale, and as sporadic events are always a possibility (Shylaya, 1991), we decided to search for another occurence of the suspected eclipse in order to confirm the interpretation of Balona et al. (1989a, b).

Observations

WR 22 has been frequently observed together with two comparison stars (HD 96287 and HD 96568), in the framework of the Long-Term Photometry of Variables project (LTPV, Sterken, 1983) at the European Southern Observatory (ESO, La Silla, Chile), with the Danish 50cm telescope equipped with the four-channel Strömgren photometer. In addition, during 1989-1990, the Liège team organized a campaign of observations on that particular star. High S/N high-resolution spectroscopic data have been acquired and will be the subject of a forthcoming publication. An intensive two-site (South Africa and Chile) photometric campaign was also set up in order to investigate the variability of both WR 40 and WR 22; we managed to get one observing run around the predicted eclipse position, but unfortunately, no data from South Africa were obtained at that crucial date. To remain consistent with the LTPV data, the ESO photometric data of the campaign were also taken at the Danish 50cm telescope. The integration time was typically 3 × 20s and WR 22 was observed approximately every ten to twenty minutes during entire nights.

Results

From an inspection of the LTPV data, we noticed that the discovery eclipse had also been observed at ESO, the minimum brightness being observed around JD 2,447,235.8. But the intrinsic variability of WR 22 prevents us from measuring the exact position on the basis of a unique eclipse. A second eclipse was observed on JD 2,447,476.83 (three cycles later) but only two measurements were obtained that night. Finally, a third eclipse was observed during our intensive campaign. The corresponding part of the lightcurve of WR 22 in the Strömgren b filter is given in figure 1. Clearly the brightness is low from JD 2,447,958.608 to JD 2,447,958.713, and, thereafter, it starts to increase. This corresponds to nine cycles after the discovery eclipse. The relative positions of the eclipses are in rather good agreement with the published period. These results definitively confirm the eclipsing binary nature of WR 22.

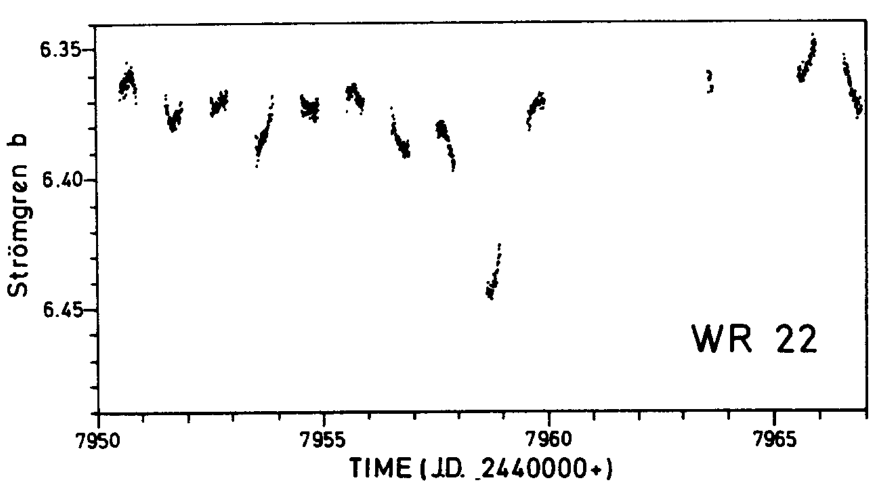


Figure 1: The lightcurve of WR 22 in the Strömgren b filter. The eclipse around JD 2,447,958.6 is clearly visible.

It seems that the eclipse is less deep in Strömgren filters than in the Johnson B one. The star changes colours during the eclipse. The magnitude and colour differences inside-eclipse *minus* outside-eclipse are

$$\Delta b = 0.071$$
$$\Delta(b-y) = -0.012$$
$$\Delta m_1 = 0.023$$
$$\Delta c_1 = -0.014\ .$$

Due to the intrinsic variability of WR 22 (clearly visible in figure 1), the above values are expected to bear a standard deviation of roughly 0.005 mag. Nothing can be said about the true nature of the eclipse (total, transit, partial...). More observations are needed in order to have a better phase coverage and to have better statistics on the intrinsic variability of WR 22 with the aim of determining the shape of the eclipses.

We searched the literature for other occurences of the eclipse; we found no observation made at the right time with the exception of the polarimetric measurements of Drissen et al. (1987). No change is visible in the polarimetry.

We folded our data in a phase diagram in order to search for the other eclipse (Wolf-Rayet behind) of the system. Despite good coverage we found no trace of such an eclipse. This result is in good agreement with the observations of Moffat and Seggewiss (1978). No other adequate measurements are available in the literature.

The inclination of the system is therefore such that the eclipse with the Wolf-Rayet in front and near the periastron is visible, whereas the eclipse near the apoastron is at best marginal (because possibly hidden by the variability of the Wolf-Rayet). Although quite possible, this puts severe constraints on the inclination i of the orbital plane. The value of i will be discussed elsewhere, together with all the other newly redetermined orbital parameters.

E. Gosset, M. Remy,
J. Manfroid, J.-M. Vreux,
Institut d'Astrophysique
Université de Liège
B-4000 Liège
Belgium

L.A. Balona,
South African Astronomical
Observatory
PO Box 19, Observatory 7935
Cape
South Africa

C. Sterken,
Astrophysical Institute
Vrije Universiteit Brussel
B-1050 Brussels
Belgium

G.A.P. Franco
Departamento de Física
UFMG Caixa Postal, 702
30.161 Belo-Horizonte-MG
Brasil

References

Balona, L.A., Egan, J., Marang, F.: 1989a, *South African Astron. Obs. Circ.* **13**, 55.

BALONA, L.A., EGAN, J., MARANG, F.: 1989b, *Mon. Not. R. Astron. Soc.* **240**, 103.

CONTI, P.S., NIEMELA, V.S., WALBORN, N.R.: 1979, *Astrophys. J.* **228**, 206.

DRISSEN, L., ST.-LOUIS, N., MOFFAT, A.F.J., BASTIEN, P.: 1987, *Astrophys. J.* **322**, 888.

LUNDSTRÖM, I., STENHOLM, B.: 1984, *Astron. Astrophys. Suppl. Ser.* **58**, 163.

MOFFAT, A.F.J., SEGGEWISS, W.: 1978, *Astron. Astrophys.* **70**, 69.

NIEMELA, V.S.: 1973, *Pub. Astron. Soc. Pacific* **85**, 220.

NIEMELA, V.S.: 1979, in *Mass Loss and Evolution of O-Type Stars*, IAU Symposium 83, eds. P.S. Conti and C.W.H. de Loore, Dordrecht: Reidel, 291.

SHYLAYA, B.S.: 1991, in *Wolf-Rayet stars and Interrelations with Other Massive Stars in Galaxies*, IAU Symposium 113, eds. K.A. van der Hucht and B. Hidayat, Dordrecht: Reidel, 125.

SMITH, H.J.: 1955, *Southern Wolf-Rayet Stars*, Ph.D. Thesis, Harvard University.

STERKEN, C.: 1983, *Messenger* **33**, 10.

UNDERHILL, A.B.: 1968, *Ann. Rev. Astron. Astrophys.* **6**, 39.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3572

Konkoly Observatory
Budapest
8 March 1991
HU ISSN 0374 - 0676

ANALYSIS OF X-RAY ECLIPSES IN SS433

Detailed X-ray light curves of SS433 (=V1343 Aql) within primary eclipse for the phases Ψ =0.11, 0.33 and 0.5 of the precessional period $162^{d}.5$ have been obtained recently (Brinkmann et al.; 1989, Kawai, 1989). Precessional phase Ψ =0 corresponds to the moment of maximum separation of the moving emissions.

Following to the results of the interpretation of the optical light curves of SS433 (Antokhina and Cherepashchuk, 1987) we try to do an analysis of these X-ray eclipsing light curves of SS433 in the framework of the Roche model of close binary system with the precessing thick accretion disk containing geometrically thick electron scattering hot nonrelativistic "jets" in its central parts. Physical grounds for the existence of such a thick nonrelativistic "jets" in SS433 have been presented by Kawai (1989). It has been supposed that the shape of X-ray eclipsing light curves is due to the eclipse of this thick nonrelativistic X-ray "jets" by the external parts of the accretion disk and by the normal star. Thin relativistic X-ray jets going out from the tops of the thick nonrelativistic "jets" are almost noneclipsing by the normal star and contribute the third noneclipsing light in the binary system. External parts of the accretion disk are described by the spheroid with the ratio of the semiaxes ("thickness") k=b/a (b and a are the semiaxes of this spheroid). The thin relativistic jets must be rather short because they have to be eclipsed by the external parts of the accretion disk (red moving FeXXV line is not observed in the X-ray spectrum of SS433). On the other hand, the thin jets have to be rather long because they are almost noneclipsed by the normal star. It helps us to constrain the "thickness" of accretion disk $k=b/a \approx 0.7$. Internal parts of the disk are conic.

The basic parameters in our model are as follows: the mass ratio for the relativistic component and for normal star $q=M_x/M_v$, the "thickness" of the accretion disk k=b/a, semiaxes of the thick nonrelativistic "jets" a_j, b_j, the angle of the cone ω describing interior parts of the disk. The filling factor μ for the normal star in its Roche lobe is supposed to be 1. Our detailed calculations show that the value of μ less than 1 is in contradic-

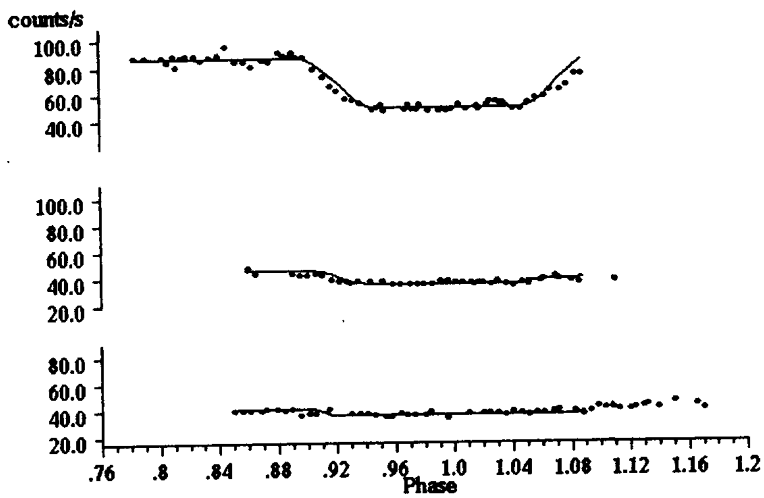


Figure 1. Observed (point) and theoretical (lines) X-ray light curves at different phases of the 162.5-day precessional period Ψ = 0.11 (top), 0.33 (centre), 0.5 (bottom).

tion with X-ray observations. The value of the semiaxis of the spheroid a for the external parts of the disk is equal to the distance between the centrum of the accretion disk and the inner Lagrangian point.

The synthesized X-ray eclipsing light curves for three phases of precessional period, Ψ =0.11, 0.33, 0.5 have been compared with observational light curves and values of the parameters q, k, a_j, b_j and ω have been determined. The shape of eclipsing X-ray light curve may be well described by the thick and thin disk, but thick disk is more preferable from the point of view described above. The obtained confidence interval for q is $0.15 \leq q \leq 0.25$.

The best solution was obtained for the values of q=0.2, k=0.7, a_j=0.1, b_j=0.2, ω =60^o (see Fig. 1). The computer simulated pictures corresponding to this model are presented in Fig. 2. For the phase Ψ =0.5 there is no satisfactory agreement between the observations if ω =60^o. But for ω =40^o we obtained a good agreement with observations (see Fig. 1). This fact can be understood taking into account the probable complicated shape of the disk.

For q=0.2 and mass function f(M)=10 $M_\odot$ (Crampton and Hutchings, 1981) the value of mass of the relativistic objects is M_x=3.1 $M_\odot$. The upper limits for for q and M_x $q \leq 0.25$, $M_x \leq 4$ $M_\odot$ obtained from analysis of X-ray eclipses are close to the lower limits for q and M_x determined by Antokhina and Cherepashchuk (1987) from the analysis of the optical light curves of SS433:

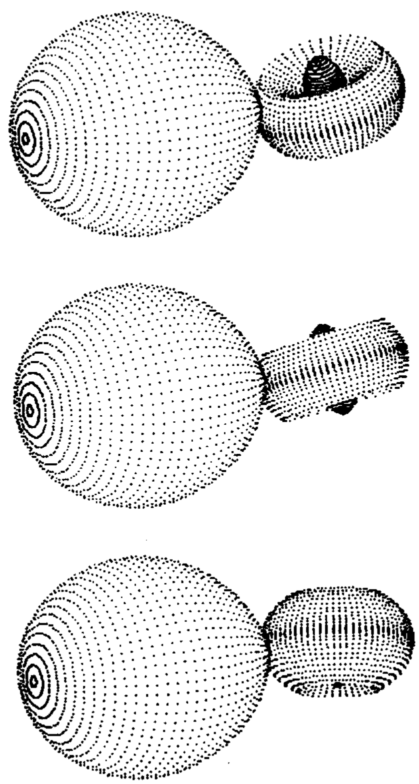


Figure 2. Computer simulated picture of X-ray eclipses in the SS433 system for three precessional phases $\psi = 0.11$ (top), 0.33 (centre), 0.5 (bottom).

$q > 0.25$, $M_x > 4\ M_\odot$. It should be noted that because the normal star overfills its Roche lobe, and the dimension of the Roche lobe is less than the level of normal star photosphere, the upper limit for q obtained from X-ray eclipses may be increased up to $q=0.3$.

It should be also noted that the value of $q=0.2-0.3$ corresponds to the total eclipse of the accretion disk by the normal star which is in conflict with the optical light curves of SS433. This problem needs further investigations.

E.A. ANTOKHINA, A.M. CHEREPASHCHUK, E.V. SEYFINA

Sternberg State Astronomical Institute
Moscow, USSR

References:

Antokhina, E.A., Cherepashchuk, A.M.: 1987, Soviet Astronomy, 31, 295.
Brinkmann, W., Kawai, N., Matsuoka, M.: 1989, Astronomy and Astrophysics, 218, L.13.
Crampton, D., Hutchings, J.: 1981, Astrophysical Journal., 251, 604.
Kawai, N.: 1989, Proc. 23d ESLAB Symp. on Two-Topics in X-ray Astronomy, Bologna, Italy (ed. N.E. White), p.453.

COMMISSION 27 OF THE I. A. U.

INFORMATION BULLETIN ON VARIABLE STARS

Number 3573

Konkoly Observatory
Budapest
11 March 1991

HU ISSN 0374 - 0676

NEW VARIABLE STARS IN THE FIELD OF IC1805

The systematic photographic search of variable stars, in blue and infrared radiation, in 5 fields of some 25 square degrees each (Maffei 1975,1977) has been continued in a field centered on the coordinates (1950.0) $\alpha = 2^h 40^m$; $\delta = +60° 30'$, with the Schmidt telescope of 65/90 cm at the Asiago Astrophysical Observatory. From 29th Sept. to 2nd Oct.1975 and from 26th Dec. 1984 to 25th Jan. 1985, 74 I-N (Hypers.) + RG5 and 74 103a-O +GG13 or without filter were collected.

The examination of these plates leads to the discovery of 35 new variable stars.

The plates were compared by means of the blink microscope at the Asiago Observatory and with the positive - negative method.

The main characteristics of the 35 variables are listed in Table I. The numeration of the variables, characterized with the prefix M, continues the one started in the field of M 16-M 17 (Maffei 1975,1977). The positions and the photometric calibration were obtained by means of the photometer Sartorius of the Specola Vaticana at Castelgandolfo. The calibration was based on the photometric sequences published by Moffat and Vogt (1974).

Table I.

Provisional Name	AR (1950.0)	DEC (1950.0)	Type	m_I max	m_I min	m_B max	m_B min	Period (days)	Epoch J.D 24......
M 278	$2^h 41^m 51^s$	62° 53'	M	12.3	15.4	(1)		311	41273
M 279	37 24	62 31	SR	13.2	16.0				
M 280	31 29	59 45	SR	13.2	15.4			465:	
M 281	47 50	59 14	M	12.2	15.5			189.5	41978
M 282	43 40	57 56	M	12.3	15.9			420	42086
M 283	25 25	60 17	M	11.4	14.5			273	41980
M 284	46 57	58 16	M	12.9	15.7			359	40127
M 285	17 54	60 20	M	12.8	15.4			228	41076
M 286	19 42	59 24	SR	14.1	<16.5				
M 287	27 11	62 32	M	7.4	10.4	14.0	<17.4	552	46076
M 288	32 42	59 10	E:	12.9	14.0	14.7	16.0		
M 289	36 33	63 14	L	12.1	12.9	(1)			
M 290	24 19	61 56	L	13.3	14.3	18.4	20.0		
M 291	56 41	61 25	E:	12.2	13.2	19.0	19.3		
M 292	22 15	59 24	L	12.8	13.6				
M 293	56 54	59 31	L	10.8	11.8	19.0	19.4		
M 294	32 46	63 24	I:	14.1	16.4				
M 295	33 38	61 48	L	11.1	12.1				

Table I. cont.

Provisional Name	AR (1950.0)		DEC		Type	m_I max	m_I min	m_B max	m_B min	Period (days)	Epoch J.D 24.....
M 296	47	05	61	27	M	10.3	12.0	17.2	19.1	166.5	40626
M 297	35	28	61	51	I	12.8	13.8	14.0	14.5		
M 298	35	09	58	50	I	10.5	11.3	16.5	18.0		
M 299	20	50	59	11	SR	9.4	10.7	15.0	17.4		
M 300	50	59	60	16	I	8.8	9.1	14.1	15.1		
M 301	24	01	60	37	I	(2)		14.6	15.8		
M 302	37	21	62	22	I	14.3	14.9	17.2	18.4		
M 303	35	17	59	31	I	11.7	12.9	13.2	14.1		
M 304	43	51	62	30	E	12.9	13.9	14.9	16.2		
M 305	55	16	61	02	I	13.1	13.7	16.8	18.1		
M 306	31	27	62	59	I	10.1	10.8	15.6	16.6		
M 307	41	00	61	52	SR	9.8	10.5	17.7	18.8	373:	
M 308	42	07	58	10	I	15.8	16.3	17.6	18.5		
M 309	41	50	60	26	I	14.4	15.2	16.9	17.7		
M 310	29	22	58	12	I	15.7	15.9	16.1	18.0		
M 311	18	29	60	57	SR:	(2)		14.1	15.2		
M 312	34	51	58	37	I:	15.6	16.1	16.8	17.7		

(1) Visible on a few plates

(2) Overexposed on all plates

The identification charts, most of the light curves and a detailed account, will be published in a more extensive work.

During this research a burst of star near the galaxy Maffei 2 was observed. This observation also will be published and discussed in a following work.

Of the 35 new variables, 8 have been classified as Mira type stars and 6 as SR. Before this research 4 Mira and 4 SR were known in the field.

This result confirms the increase of the number of long-period variable stars when the observations are made by means of the infrared technique. However in this region (galactic anti-center) the increase is not so dramatic as in the field of M 16 - M 17 neither so remarkable as in that of γ Cygni.

Many thanks are due to Fth. G. V. Coyne, Director of the Specola Vaticana for the use of the photometer Sartorius and for the kind hospitality.

Vania Gasperoni - Paolo Maffei - Gino Tosti

Cattedra di Astrofisica
Università di Perugia, Italia

References

Maffei P., 1975, *Inf. Bull. Var. Stars* n. 985

Maffei P., 1977, *Inf. Bull. Var. Stars* n. 1302

Moffat A. F. J. and Vogt N. J., 1974, *Veröff.Astr.Inst. Bochum* n.2

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3574

Konkoly Observatory
Budapest
11 March 1991

HU ISSN 0374 - 0676

V1963 Sgr - A new W UMa type star

The variable star V1963 Sgr was discovered by means of infrared photographic observations carried out with the 60 cm reflector at Loiano Astronomical Station (Maffei, 1963). These observations (19 plates in the years 1957 and 1959) together with the ones obtained with the 126 cm reflector at Asiago Observatory (30 plates during the years 1960+1962), were too sparse and sporadic and then allowed to define only the nature of V1963, i.e. an eclipsing variable, problably of type EA:, with P = $2^d.421/n$.

Blue and infrared wide field photographs of the sky region including V1963 Sgr were obtained with the 65/90 cm Schmidt telescope at the Asiago Observatory (104 plates, during the years 1967+1971 and 1975) and with the 40/60 cm Schmidt telescope at the Catania Astrophysical Observatory (129 plates in the year 1980). The photographic emulsions and filter used were: I-N (hypers.) + RG5 for the 117 infrared plates, and 103a-0 + GG13 for the 116 blue ones. All the blue and infrared plates but a few, were obtained in pairs during the same nights. The magnitudes were estimated visually. The errors turned out to be $0^m.05 + 0^m.2$ depending both from telescope and from seeing.

On the basis of the new observations V1963 Sgr seems to be an eclipsing variable of W UMa-type with the following characteristics:

m_{pg}	m_{ir}	Epoch	Period
16.4 -17.4	11.7 -14.0	2440124.3104	1.407205303

Figures 1 and 2 show the blue and infrared light curves derived from all the observations in 1957+1980 corresponding to 5535 periods.

The dispersion of points around the maxima and the width of minima in fig.1 and fig. 2, may be due to occasional variations of the shape of the light curve and/or of the period, both of which are common phenomena in W UMa type stars. The O - C values for the observed primary minima are given in the following table.

J.D 24......	O - C	J.D 24.......	O - C
36755.5160	$0^d.055$	42688.2560	$0^d.018$
37173.4290	0 .028	44354.5583	0 .189
37190.3545	0 .067	44430.4279	0 .069
39599.3991	0 .065	44437.4297	0 .035
40124.3104	0 .0	44461.3891	0 .072
41068.6244	0 .079	44468.4372	0 .084

The comparison of the light curves shows a normal behaviour in the blue in contrast to a very large amplitude in the infrared.

The color index (m_B-m_I) is $3^m.4$ at minimum and $4^m.3$ at maximum but it cannot be indicative of the spectral type because the system is certainly affected by reddening.

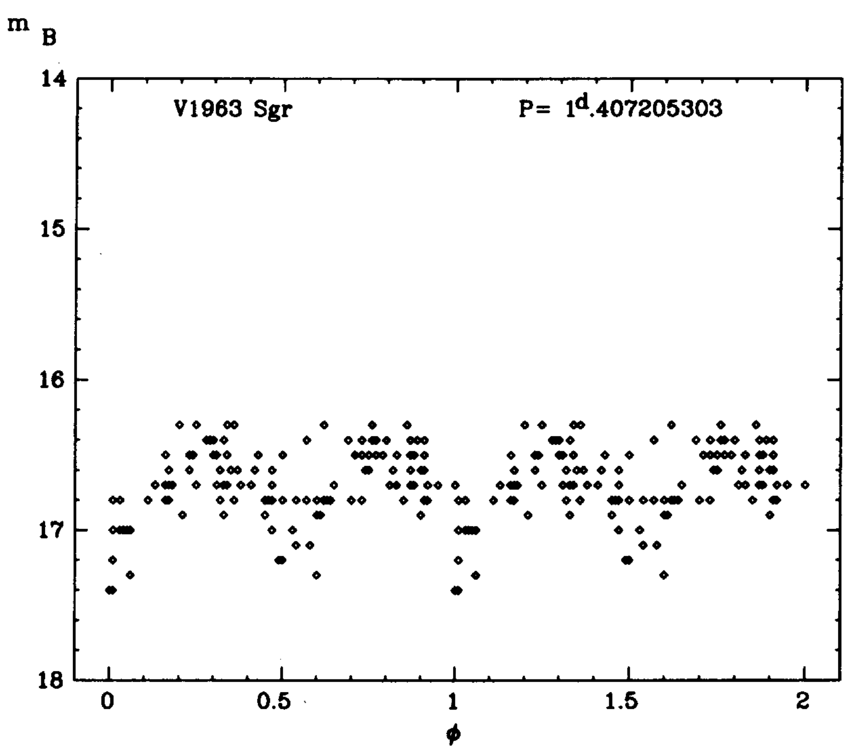


Fig.1

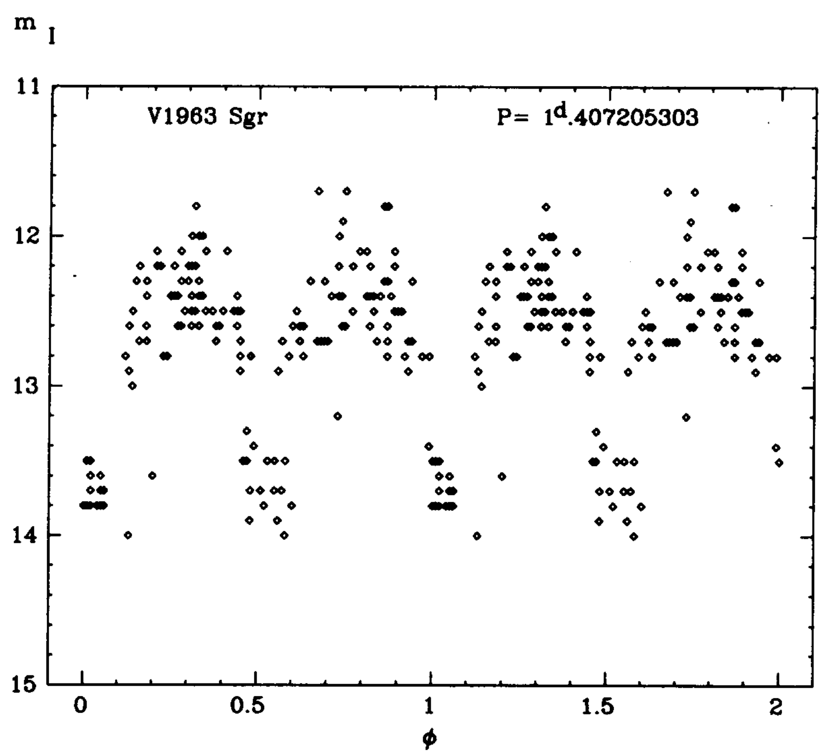


Fig.2

In the *IRAS Point Source Catalog* (1987) there are two sources associated to V1963 Sgr :

NAME	$F_{12\mu}$	$F_{25\mu}$	$F_{60\mu}$	$F_{100\mu}$
		(Jy)		
IRAS 18164 - 1631	<9.9	22.5	735	<2940
IRAS 18164 - 1632	9.9	<22.5	<869	<2940

These observations strongly support the idea that the system is surrounded by dust typically in the form of a dense circumsystem envelope or disk.

We point out that, according to the 4th edition of *General Catalog of Variable Stars* (GCVS), V1963 Sgr is the first W UMa-type variable discovered with infrared observations. Taken into account that all known W UMa-type stars have been discovered during blue or visual surveys, we suggest that the systematic infrared surveys may increase the number of the known variables of this type and improve the knowledge of their nature.

Paolo Maffei - Gino Tosti

Cattedra di Astrofisica
Università di Perugia,Italia

Reference

Kolopov et al.,1987, *General Catalog of Variable Stars*, IV Ed.,Vol III, Moscow
IRAS Point Sources Catalog. 1987, U.S. Government Printing Office, Washington
Maffei P. ,1963,*Mem SAIt*, 34,441

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3575

Konkoly Observatory
Budapest
12 March 1991
HU ISSN 0374 - 0676

PHOTOELECTRIC OBSERVATION OF VW CEPHEI IN R AND IR

VW Cep (BD+75°0752) is a W UMa-type eclipsing binary remarkable for peculiar variation of its light curve for which Yamasaki (1982) suggested a spot model. So far observations in UBV have been often made by various authors (e.g., Abe 1982, Karimie 1983), but only few red and infrared observation have been published (e.g., Linnell 1982). Red and infrared observation of VW Cep would be important to study the validity of the spot model. The present observation is to consolidate the red and infrared data of VW Cep.

Our observations were carried out during nine nights in December 1989 and January 1990 with an SSP-3 detector attached to a 28-cm (f=2,800mm) Schmidt-Cassegrain type telescope. Two filters with peak transmission at 670nm for red and 880nm for infrared were used throughout the observations. BD+74°889 was used as the comparison star, which is the same one as used in the previous works (e.g., Karimie 1983, Linnell 1982).

The present observations could cover four primary and two secondary minima, as shown in Table I, where the O-C values were calculated with the ephemeris:

$$\text{Min I} = \text{JD Hel } 2444157.4131 + 0^{d}.27831460 \cdot E$$

which has been taken from the General Catalogue of Variable Stars (1985).

The obtained light and color curves in R and IR are shown in Figure 1, where the light curve is shown by individual observations while the color curve in R-IR by normal points. It is found that the general feature of the light curve is quite consistent with the previous one by Linnell (1982).

Table II shows values of ΔR, ΔIR and Δ(R-IR) of VW Cep obtained from the present observation. In this table the corresponding values taken from Linnell's (1982) work are also shown in parentheses, as a comparison. Table III shows amplitudes of Max I - Max II, Max I - Min I and Max II - Min II in ΔR, ΔIR and Δ(R-IR), respectively. The numbers in parentheses are the ones read from Table 4 of Linnell's (1982) paper.

I would like to express my hearty thanks to JAPOA members who kindly helped during the observation as well as in the subsequent reduction work.

Table 1.
The times of observed minima of VW Cep

Hel.J.D 2440000+	s.d.	E	filter	O-C
7892.0693	±0.0002	13419	R	-0.0474
7892.0698	±0.0001	13419	IR	-0.0469
7895.9649	±0.0001	13433	R	-0.0482
7895.9641	±0.0002	13433	IR	-0.0490
7896.9416	±0.0002	13436.5	R	-0.0456
7896.9403	±0.0001	13436.5	IR	-0.0469
7899.0270	±0.0001	13444	R	-0.0476
7899.0274	±0.0001	13444	IR	-0.0472
7905.0135	±0.0003	13465.5	R	-0.0449
7905.0121	±0.0001	13465.5	IR	-0.0463
7912.9418	±0:0001	13494	R	-0.0485
7912.9439	±0.0001	13494	IR	-0.0464

Table 2.
ΔR, ΔIR and Δ(R-IR) values of VW Cep at maxima and minima.

Phase	Δ R	Δ IR	Δ (R-IR)
Maxima I	-0.633±0.017 (-0.650)	-0.743±0.018 (-0.730)	0.110 (0.133)
minima I	-0.262±0.020 (-0.280)	-0.419±0.010 (-0.393)	0.157 (0.163)
Maxima II	-0.598±0.008 (-0.615)	-0.720±0.022 (-0.703)	0.122 (0.135)
minima II	-0.358±0.004 (-0.348)	-0.499±0.006 (-0.435)	0.141 (0.143)

Table 3.

Three amplitudes of Max I - Max II, Max I - Min I and Max II - Min II in ΔR, ΔIR and Δ(R-IR).

Phase	ΔR	ΔIR	Δ(R-IR)
Max I - Max II	-0.035(-0.035)	-0.023(-0.027)	-0.012(-0.002)
Max I - Min I	-0.371(-0.371)	-0.324(-0.337)	-0.047(-0.030)
Max II - Min II	-0.242(-0.267)	-0.221(-0.268)	-0.021(-0.008)

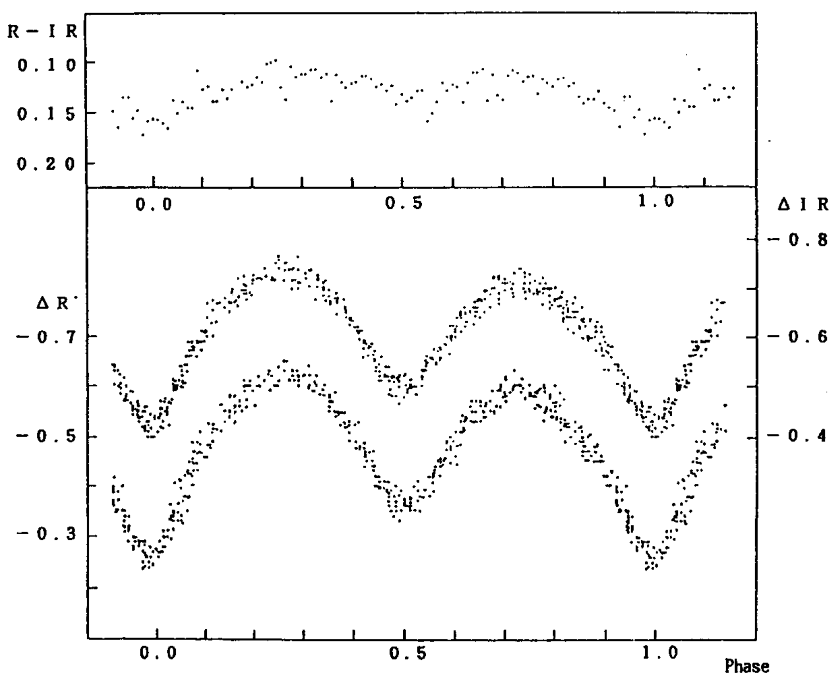


Figure 1.
R and IR Light curves(lower) of VW Cep shown by individual observations and the corresponding color curve(upper) by the mean of several individual ones.

In particular, my sincere gratitude is due to Prof. M. Kitamura of National Astronomical Observatory for his valuable suggestion and constant encouragement throughout the work. Thanks are also extended to Messrs. S. Ohmori, O. Ohshima and Y. Ito for useful advice.

KIKUICHI ARAI

Member of Japan Amateur Photoelectric
Observers Association (JAPOA) and

Kuki-Hokuyo Senior High School
Kukihon 837-1, Kuki City,
Saitama Prefecture, Japan 346.

References:

Abe, T.: 1982, I.B.V.S., No.2108.
Karimie, M.T.: 1983, Astrophys. Space Sci., 92, 53.
Kholopov, P.N. (Editor-in-Chief): 1985, General Catalogue of Variable Stars, 4th edition, Moscow, Nauka Publishing House.
Linnell, A.P.: 1982, Astrophys. J. Suppl., 50, 85.
Yamasaki, A.: 1982, Astrophys. Space Sci., 85, 43.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3576

Konkoly Observatory
Budapest
12 March 1991
HU ISSN 0374 - 0676

A VERY INTERESTING VARIABLE V 627 Cas (AS 501): BRIGHTENING FORECAST FOR MID-1991

Herbig and Rao (1972) included the object AS 501 (designated as V 627 Cas) from the list of Merrill and Burwell (1950) into the second catalogue of young stars with a sense of doubt. The spectral class of the star is around M2-M4 with H, TiI, FeI and FeII emission lines. It shows marked overabundances in the UV and IR emission and high level of linear polarization, OH and H_2O maser emission has been also found in the direction toward this object. The problems connected with the uncertainty in the evolutionary status of V 627 Cas were earlier discussed in details by Derviz and Kopatskaya (1981), Kolotilov (1988) and Bergner et al. (1988).

The UBVRIK observations were carried out in 1974-1984 by Kopatskaya (1986) did not show any periodicity in the optical light variability. The results of UBVRIJHKLM photometry of V 627 Cas carried out in 1983 - 1988 are published in the papers of Taranova and Yudin (1987), Goransky and Kolotilov (1988) and Bergner et al. (1988). In particular Kolotilov (1988) suspected the presence of an optical burst with the period close to 900 days.

In 1988-1990 we proceeded the optical and IR photometry of V 627 Cas, the results of which are to be published elsewhere. Figure 1 shows the light curve of V 627 Cas in the V band folded with the period of 900 days through the whole bulk of 1983 - 1990 data. The maxima were observed in the end of 1983, in mid-1986 and in the end of 1988, the next brightening is forecasted for mid-1991. The brightness of V 627 Cas in 1983 - 1990 in the IR bands did not show any visible changes ($\Delta J \leq 0\overset{m}{.}1$).

Let us note that, in addition to the photometric measurements, one of the authors (A.S.M.) obtained the record of V 627 Cas on the 6-m telescope of the Special Astrophysical Observatory in the wavelength range $\lambda\lambda$ 3816 - 5664 A. The observations were made in January 1989. Primarily, numerous TiO absorption bands and the H_β emission are evident here. Later, in August 1989 the record of the spectrum in the wavelength range $\lambda\lambda$ 4000 - 7500 A was obtained by Mendoza et al. (1990). It shows the TiO bands and the H_α emission.

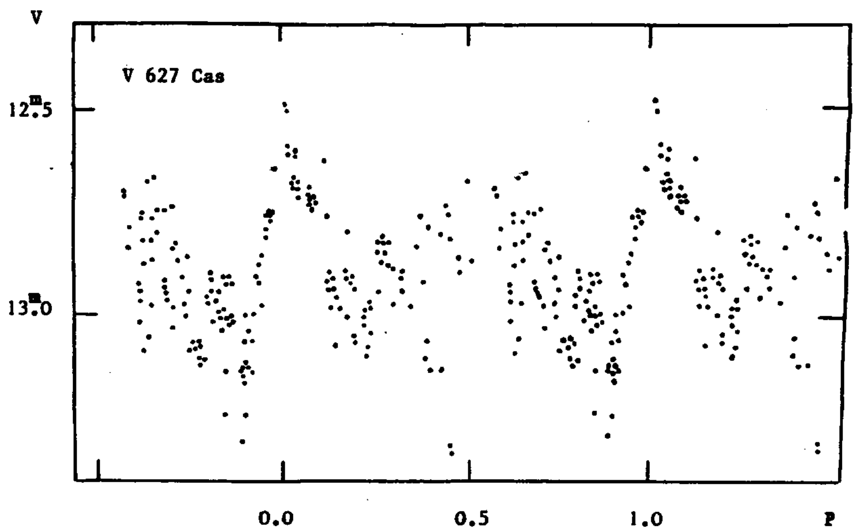


Figure 1

Earlier Kolotilov (1988) undertook an attempt to classify V 627 Cas as a nova-like symbiotic star. In this case the periodicity of the light curve could have been associated with the orbital period of the system. However, V 627 Cas differs from the known symbiotic stars by a number of parameters.

On the other hand, V 627 Cas cannot be classified as a young star of T Tau type. Particularly, on the IR color diagrams (in the range 2.2-60 μm) it coincides with the OH/IR stars. Besides, if we regard it as a member of young stellar association near DI Cep, the bolometric flux from V 627 Cas calculated with respect to the IRAS data being $F_{bol} \approx 1.4 \cdot 10^{-7}$ erg/cm^2 sec is about 30 times as high as the one from DI Cep, belonging to typical T Tau stars.

Thus, the evolutionary status of V 627 Cas still remains uncertain. Formally, it is possible to interpret the available observational data assuming that we observe a peculiar red giant and a young star in the same direction. In the opposite case we are probably dealing with a symbiotic system, where the hot component is showing very violet ($\Delta U \approx 0^m.6$ at $B \approx$ constant), or very blue ($\Delta B \approx 0^m.5$ at $V \approx$ constant) emission bursts.

Having noticed peculiar characteristics of the variable V 627 Cas and forecasting its brightening, we are calling the astronomical community for various patrol observations of this star.

E.A. KOLOTILOV

Crimean Laboratory of the Shternberg State Astronomical Institute, U.S.S.R., 334413, Nauchny, Crimea

A.S. MIROSHNICHENKO

Main Astronomical Observatory U.S.S.R., 191140, Leningrad, Pulkovo

B.F. YUDIN

Shternberg State Astronomical Institute, U.S.S.R., 119899, Moscow, Universitetskyi prospect, 13

References:

Bergner, Yu.K., Miroshnichenko, A.S., Yudin, R.V., Yutanov, N.Yu., Kuratov, K.S. and Mukanov, D.B.: 1988, Pis'ma Astron. J., 14, 616.

Derviz, T.E., Kopatskaya, E.N.: 1981, Pis'ma Astron. J., 7, 168.

Goransky, V.P., Kolotilov, E.A.: 1988, Variable Stars, 22, 667.

Herbig, G.H., Rao, K.N.: 1972, Astrophys. J., 174, 401.

Kopatskaya, E.N.: 1986, Dissertation, Leningrad University.

Kolotilov, E.A.: 1988, Astrofizika, 29, 458.

Mendoza, E.E., Rolland, A. and Rodriguez, E.: 1990, Astron. Astrophys. Suppl. Ser., 84, 29.

Merrill, P.W., Burwell, C.G.: 1950, Astrophys. J., 112, 72.

Taranova, O.G., Yudin, B.F.: 1987, Astron. Tsirkular, No.1501, 7.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3577

Konkoly Observatory
Budapest
14 March 1991
HU ISSN 0374 - 0676

SIMULTANEOUS PHOTOELECTRIC OBSERVATIONS OF AD LEONIS

As a part of the programme for investigation of fast (several seconds) flares and short time-scale variations on late spectral classes stars (flare stars, cataclysmic variables, red giants et al.) at the Department of Astronomy of the Bulgarian Academy of Sciences, simultaneous photometric monitoring of the flare star AD Leo was carried out on February 3, 1990.

The observations were made in U-colour of the standard UBV system using two identical single channel photon-counting photoelectric photometers, attached to 60 cm Cassegrain telescopes in the National Astronomical Observatory Rozhen and in the Belogradchik Astronomical Observatory. The photometers used have been described by Panov et al. (1982) and Antov et al. (1991). The altitude above the sea level is 1750 m at Rozhen and 630 m at Belogradchik. The distance between them is 270 km. The accuracy in the time synchronization between the two observatories was approximately 2 sec.

The star with coordinates $\alpha_{1950}=10^h16^m48^s$, $\delta_{1950}=20^0 8'.5$ was used as a comparison star for the observations made at Belogradchik and for the observations made at Rozhen. du(mag) is the difference between AD Leo and the comparison star in the instrumental system. The amplitude of the flares Δm_u was calculated regarding the quiet state phase of the star AD Leo immediately before flare.

The data processing has been made by Kirov, Antov and Genkov's program system (Kirov et al. (1990)).

The integration time was 1 sec. The monitoring intervals in U.T., as well as the total monitoring time for the night are given in Table 1. The standard deviation of random noise fluctuation σ_{mag} was calculated when the intensity in impulses was lessened with the sky background. They are $\sigma_{mag} \leq 0.06$ for the observations at Rozhen and $\sigma_{mag} \leq 0.09$ for the observations at Belogradchik.

Table 1

Monitoring intervals (U.T.) in 3/4 Feb 1990

Monitoring intervals (U.T.)	σ (U.T.)
(at Rozhen)	
$19^h37^m18^s$–$19^h52^m23^s$, $19^h54^m07^s$–$20^h13^m41^s$	007(19^h44^m),006(20^h04^m)
20 15 49-20 37 41,20 39 12-21 06 00	007(20 26),005(20 52)
21 08 19-21 30 23,21 33 38-21 54 53	005(21 19),005(21 44)
21 56 50-22 18 45,22 26 12-22 50 59	004(22 07),004(22 36)
22 52 27-23 22 38,23 24 58-23 43 15	004(23 07),005(23 35)
23 45 55- 0 11 14, 0 27 50- 0 36 31	004(23 58),005(0 32)
Total monitoring time $4^h15^m38^s$.	
(at Belogradchik)	
$21^h04^m35^s$–$21^h06^m16^s$, $21^h08^m02^s$–$21^h17^m56^s$	010(21^h05^m),009(21^h12^m)
21 18 12-21 29 15,21 30 30-21 40 08	010(21 23),009(21 35)
21 40 25-21 50 57,21 51 58-22 01 53	010(21 44),009(21 55)
22 02 05-22 10 52,22 11 58-22 26 03	011(22 05),009(22 18)
22 27 02-22 41 29,22 42 32-22 55 22	010(22 33),009(22 48)
22 55 39-23 09 36,23 19 05-23 31 45	010(23 02),008(23 29)
23 31 58-23 39 32,23 40 30-23 51 56	007(23 35),008(23 45)
23 52 13- 0 03 32, 0 04 41- 0 18 50	008(23 57),006(0 11)
0 19 07- 0 30 22, 0 31 20- 0 45 04	009(0 25),009(0 38)
0 45 18- 0 54 37, 0 55 56- 1 05 35	008(0 49),005(1 00)
1 05 50- 1 15 35, 1 16 45- 1 28 03	008(1 10),008(1 22)
1 28 19- 1 39 15, 1 40 15- 1 49 49	006(1 33),008(1 45)
1 50 07- 1 54 50	007(1 52)
Total monitoring time $4^h28^m17^s$.	

Table 2

Date	Flare no.	U.T. max	t_b min	t_a min	Duration min	$\frac{I_f - I_0}{I_0}$	Δm_u	σ_{mag}
3/4 Feb 1990	1 R.	$21^h09^m44^s$	0.07	0.12	0.19	0.37	0.34	0.07
	B.	21 09 47	0.07	0.12	0.19	0.47	0.42	0.10
	2 R.	21 46 35	0.5	14.0	14.5	1.11	0.81	0.05
	B.	21 46 36	0.5	14.0	14.5	1.16	0.84	0.10
	2a R.	21 48 58	0.07	0.10	0.17	0.19	0.19	0.05
	B.	21 48 59	0.07	0.10	0.17	0.16	0.16	0.06
	3 R.	23 33 26	0.3	1.5	1.8	0.96	0.73	0.05
	B.	23 33 28	0.3	1.5	1.8	1.18	0.84	0.08

R. – Rozhen, B. – Belogradchik

Three flares were observed during the 4.26 hours total monitoring time at Rozhen and 4.47 hours at Belogradchik. The data for these flares are given in Table 2 in the following form:

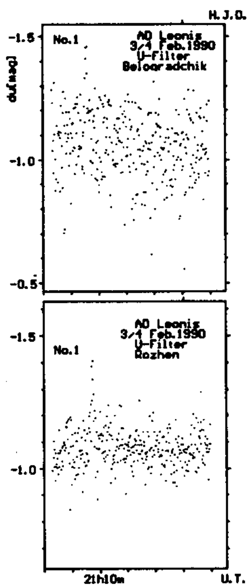


Figure 1

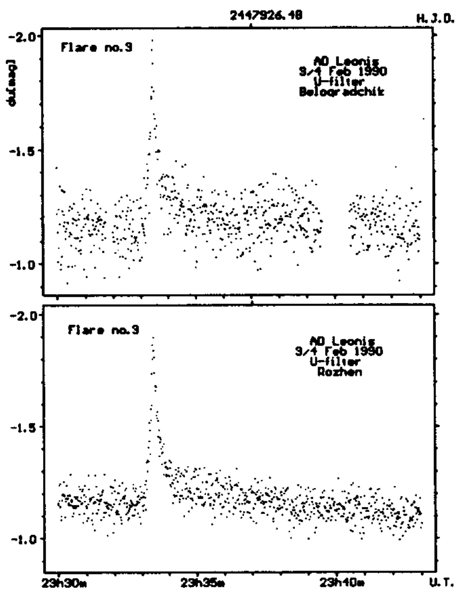


Figure 2

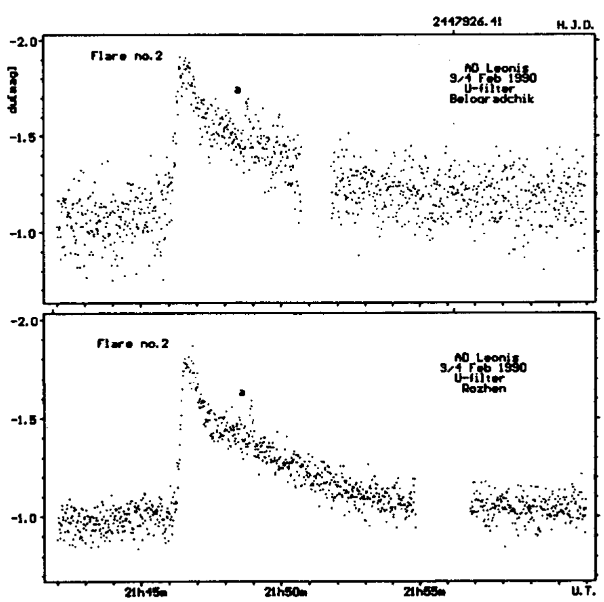


Figure 3

- date;
- number of the flare;
- U.T. of the maximum;
- the duration before and after the maximum (t_b and t_a respectively), as well as the total duration of the flare;
- the value of the ratio $(I_f-I_0)/I_0$ corresponding to the flare maximum, where I_0 is the intensity in impulses of the quiet star lessened with sky background and I_f is the total intensity in impulses of the star plus flare lessened with the sky background.
- the increase of the stellar brightness of the star at flare maximum Δm_u, where m_u is the ultraviolet magnitude of the star in the instrumental system;
- the standard deviation of random noise fluctuation $\sigma_{mag}= 2.5\log(I_0+\sigma)/I_0$, during the quiet-state phase immediately preceding the beginning of the flare.

The light curves of the observed flares are shown in Fig. 1–3. Some small details from the light curves obtained at Rozhen and Belogradchik with a good coincidence are seen. A detail is pointed out with the small letter 'a'. Data for the flares and the detail are given in Table 2. There are indications for decreasing of the brightness just before the flare no.2.

A. P. Antov, V. V. Genkov, R. Konstantinova–Antova
Bulgarian Academy of Sciences
Department of Astronomy
bul. Lenin 72
1784 Sofia, BULGARIA

N. K. Kirov
Bulgarian Academy of Sciences
Institute of Mathematics
ul. Acad. G. Bonchev, bl. 8
1113 Sofia, BULGARIA

References:

Panov K.P., Pamukchiev I.Ch., Christov P.P., Petkov D.I., Notev P.T., Kotsev N.G., 1982: Compt. Rend. Bulg Acad. Sci. 35, no.6, p.717.

Kirov N.K., Antov A.P., Genkov V.V., 1990: in preparation.

Antov A.P., Genkov V.V., Kirov N.K., Konstantinova–Antova R.K., Staikov Yu., Nikov Ch.N., Sediankov S.S., Yaramov K., Pamukchiev I.Ch., Notev P.T., Kotsev N.G., 1991: in preparation.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3578

Konkoly Observatory
Budapest
15 March 1991
HU ISSN 0374 - 0676

CCD PHOTOMETRY OF BX PEGASI IN 1990

Seven hundred and thirty-four CCD images of the W UMa type star BX Peg were obtained by the authors during the Fall of 1990 using the U. S. Naval Observatory 0.61-meter Cassegrain telescope at Washington, DC and a Metachrome-II coated Thomson CSF THX31156 1Kx1K CCD. The effective field of view is approximately eight arc minutes square at prime focus. A "wide red" (H alpha-H beta-calcium) filter was employed for 706 images and "v" (GG495(2.6mm) + BG39(1.8mm)) was used for 28 images.

The DAOPHOT photometry package, Stetson (1987), was used in synthetic aperture mode for five of the brightest stars in the CCD field. Differential instrumental magnitude light curves were constructed for each night's run. The method of Kwee and van Woerden (1956) was used to determine the times of minima. Ephemerides given by Samec (1990) produced light curves where the primary minima were shifted approximately -0.1 phase. An O-C diagram based on Samec's linear ephemeris and table of times of minima and our time of minima reveals an apparent instantaneous period change which occurred near Julian Date 2446700.0. Photoelectric and CCD times of primary minima from Samec and wide red filter primary times from this study were used in a linear least squares fit to improve the ephemerides. The following new linear ephemerides were found for the associated time intervals.

2443790 to 2446700

$$\text{JD Hel Min I} = \underset{\pm 28}{2445651.32225} + \underset{\pm 6}{0.28042068} * E \qquad (1)$$

2446700 to present

$$\text{JD Hel Min I} = \underset{\pm 31}{2448174.53105} + \underset{\pm 10}{0.28041747} * E \qquad (2)$$

Figure 1 is the "wide red" filter differential magnitudes versus phase computed using Equation 2. Cycle to cycle variations in the light curve are evident. Table 1 gives the times of primary and secondary minima found in this study reduced to Equation 2. Figure 2 is a plot of the O-C's of all known photoelectric and CCD determined minima reduced using Equation 2. Minima given in Samec are denoted with asterisks and minima from this work with filled circles. Secondary minima were shifted by one half cycle for plotting. Lines indicate the two periods over the interval of applicability.

Table 1. New observed epochs of primary and secondary minima fit to Equation 2.

PRIMARY MINIMA

Filter	HJD	Mean Error (Days)	Cycles	O-C (Days)
"wide red"	2448174.5303	0.000119	0.0	-0.0008
"wide red"	2448213.5094	0.000113	139.0	0.0003
"wide red"	2448225.5672	0.000098	182.0	0.0002
"V"	2448225.5681	0.000697	182.0	0.0011

SECONDARY MINIMUM

Filter	HJD	Mean Error (Days)	Cycles	O-C (Days)
"wide red"	2448191.49887	0.000151	60.5	0.0026

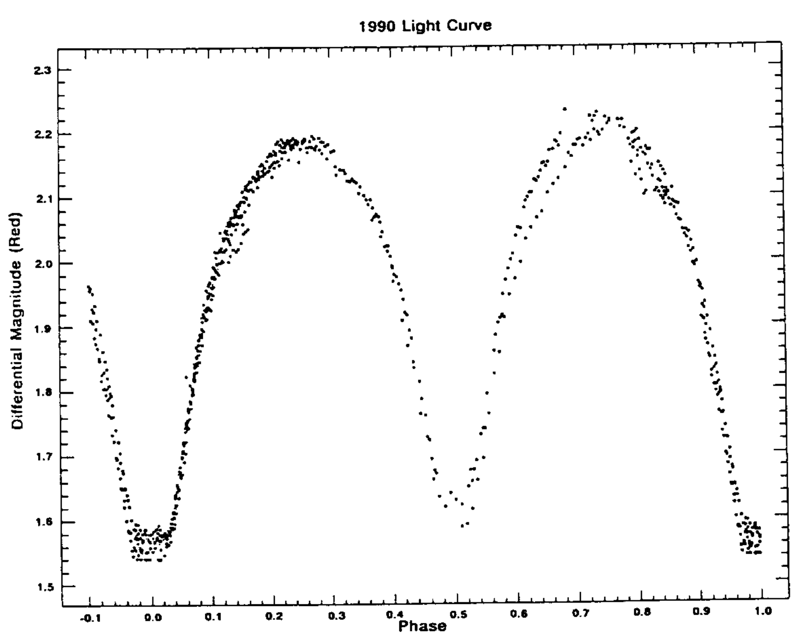


Figure 1

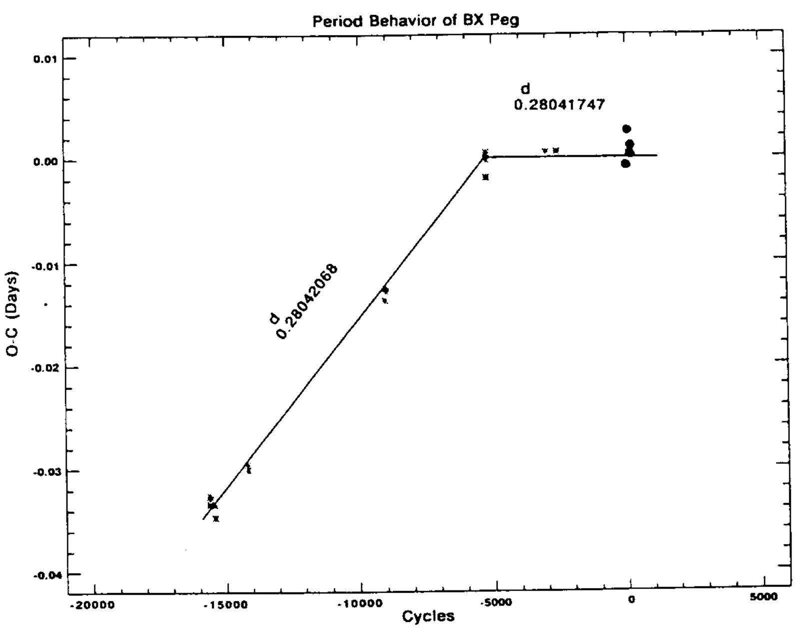


Figure 2

James A. DeYoung
Richard E. Schmidt
Larry I. Gritz
U. S. Naval Observatory
34th & Mass. Ave. NW
Washington DC 20392 USA

Kwee, K. K. and van Woerden, H., 1956, *Bull. Astron. Netherlands 12*, 327.
Samec, R. G., 1990, *Astron. Journ. 100*, 808.
Stetson, P. B., 1987, *Publ. Astron. Soc. Pacific 99*, 191.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3579

Konkoly Observatory
Budapest
15 March 1991

HU ISSN 0374 - 0676

A NEW ECLIPSING VARIABLE IN THE BX PEGASI FIELD

A new eclipsing variable star has been discovered near BX Peg during a study of this W UMa type star, DeYoung et al., (1991). The U. S. Naval Observatory 0.61-meter Cassegrain telescope at Washington, DC and a Metachrome-II coated Thomson CSF THX31156 1Kx1K CCD was employed in a program to determine times of minima of eclipsing variable stars. A "wide red" (H alpha-H beta-calcium) filter was used for 701 images and "v" (GG495(2.6mm) + BG39(1.8mm)) was used for 28 images.

The DAOPHOT photometry package, Stetson (1987), was used in synthetic aperture mode for five of the brightest stars in the CCD field. On the first night the light curve of BX Peg was skewed. The brightest comparison star was determined to be variable. A search of the *General Catalogue of Variable Stars* (1985), *The New Catalogue of Suspected Variable Stars* (1982) and the various *IBVS* issues published since 1985 revealed no object corresponding with the new variable. Subsequent observations revealed variations that confirm an Algol type eclipsing variation. Differential instrumental magnitude light curves were constructed for each night's run. The method of Kwee and van Woerden (1956) was used to determine the times of well observed minima (see Table 1). Using the four well observed minima and four partially observed minima, an estimate of the period yielded a value of 0.816 days. A period search using a discrete Fourier transform method based on Scargle (1982) and a Jurkevich search method based on Morris and DuPuy (1980) proved to be inconclusive, with the 0.816-day period only weakly indicated. A trial of all other suggested periods in the periodograms showed that no other period fit the data. A linear least squares fit to the four well observed minima gives the following preliminary ephemeris.

$$\text{JD Hel Min I} = \underset{\pm 11}{2448158.5675} + \underset{\pm 19}{0.816384} * E \qquad (1)$$

The following data were found in the *Space Telescope Guide Star Catalog* (CD ROM Version 1 issued on 1 June 1989) on the new eclipsing variable.

Right Ascension (J2000.0)	Declination (J2000.0)	m_v
$21^h 39^m 10^s.7$	+26° 42' 34"	12.07

Table 1. New observed epochs of primary and secondary minimum fit to Equation 1.

PRIMARY MINIMA

Filter	HJD	Mean Error (Days)	Cycles	O-C (Days)
"wide red"	2448158.5685	0.000358	0.0	-0.0010
"wide red"	2448225.5122	0.000276	82.0	-0.0012
"v"	2448225.5099	0.000697	82.0	0.0012

SECONDARY MINIMUM

Filter	HJD	Mean Error (Days)	Cycles	O-C (Days)
"wide red"	2448160.6075	0.000409	3.5	0.0010

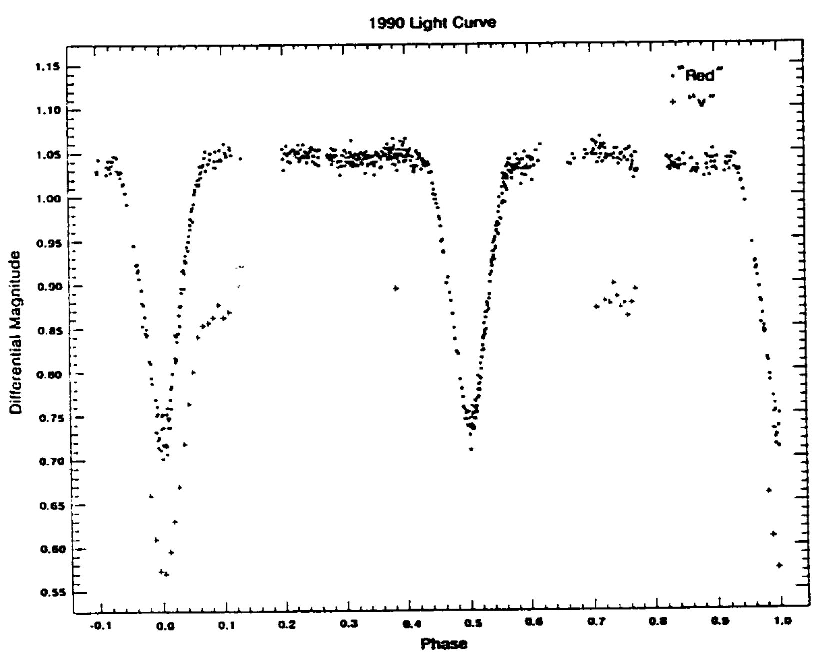


Figure 1

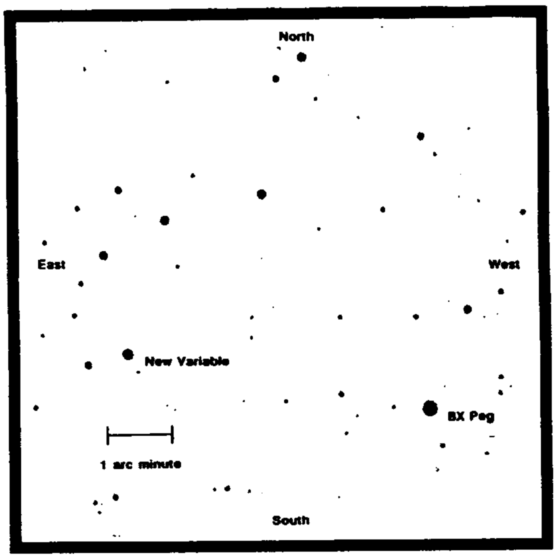


Figure 2

The magnitude at maximum is 12.1 in the "v" filter, determined by differential measures with respect to BX Peg when both the new variable and BX Peg were at maximum. Our maximum magnitude agrees well with the data from the *Guide Star Catalog*. The observed instrumental amplitude of primary minimum is 0.31 in the "v" filter. Figure 1 shows the instrumental differential "wide red", indicated by small boxes, and "v" magnitudes, indicated by plus symbols, versus phase computed using Equation 1. Figure 2 is a "wide red" image finder chart for the new variable. Table 1 gives the times of primary and secondary minima found in this study reduced to Equation 1.

James A. DeYoung
U. S. Naval Observatory
34th & Mass. Ave. NW
Washington DC 20392 USA

References:

DeYoung, J. A., Schmidt, R. E., and Gritz, L. I., 1991, (to appear in the *Information Bulletin on Variable Stars*).

Kholopov, P. N., (ed.), 1982, *New Catalogue of Suspected Variable Stars*, Nauka, Moscow.

Kholopov, P. N., (ed.), 1985, *General Catalogue of Variable Stars*, 4th ed., Nauka, Moscow.

Kwee, K. K. and van Woerden, H., 1956, *Bull. Astron. Netherlands, 12*, 327.

Morris, S. and DuPuy, D., 1980, *Publ. Astron. Soc. Pacific, 92*, 303.

Scargle, J., 1982, *Astrophys. J., 263*, 835.

Space Telescope Science Institute, 1989, *Guide Star Catalog* (CD ROM, Ver. 1), Baltimore.

Stetson, P. B., 1987, *Publ. Astron. Soc. Pacific, 99*, 191.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3580

Konkoly Observatory
Budapest
20 March 1991

HU ISSN 0374 - 0676

PHOTOELECTRIC PHOTOMETRY OF THE SUSPECTED CATACLYSMIC VARIABLE PG 0900+401

The object PG 0900+401 was suspected to be a new cataclysmic variable after the observations by Ferguson *et al.* (1984). They observed peculiar absorption lines in the spectrum of the star and suggested a thick accretion disk around the compact object responsible for these lines. Ferguson *et al.* obtained photoelectric photometry for the star: V = $12^{m}.87$, B-V = +$0^{m}.23$, U-B = -$0^{m}.96$, V-I =+$0^{m}.58$. The spectrum of the secondary corresponds to K3.

We started to observe the star PG 0900+401 photoelectrically in November, 1987. Now we have 15 nights of observations of the star during the interval JD 2447101 - 2448003. The observations at the date JD 2447292 were carried out by I.M.Volkov. In total it has been obtained 83 U, 280 B, 100 V, 4 R, and 5 W observations (the description of the W system can be found in Straižys, 1977). In the vicinity of the star PG 0900+401 also 11 nearby stars have been measured photoelectrically (the stars *a* - *n* in Fig.1 and in Table). The star "*g*" has been used as a comparison star in observations of PG 0900+401.

*	V	B	U	BD+40°
a	$6^{m}.366$	$6^{m}.673$	$6^{m}.703$	2138
b	9.29	10.30	11.0:	2147
c	10.10	10.73	10.67	2139
d	10.30	11.01	11.14	2154
e	10.84	11.39	11.33	
f	10.85	11.61	11.81	
g	11.738	12.183	12.12	
h	11.98	12.47	12.34:	
k	12.66	13.60	14.20:	
m	13.07	13.74	13.53:	
n	13.49	14.12	14.08:	
1		12.54		
2		12.76		
3		13.04		
4		13.24		

a: W= $6^{m}.64$ R= $6^{m}.08$
g: W=11.91 R=11.38

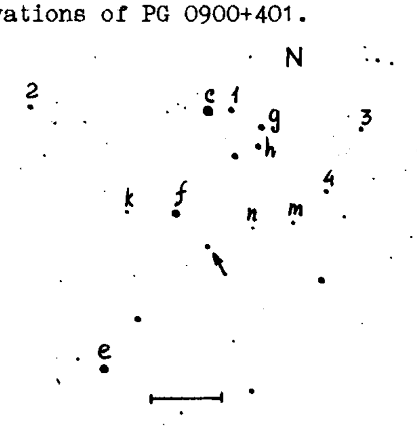


Figure 1

Remark : The stars *a*,*b*,*d* are outside the map.

Measurements were carried out with the one-channel photometers designed by V.M.Lyutyj, I.M.Volkov,and A.K. Magnitskij mounted at the 60-cm reflector in Crimea, 48-cm reflector at the Tian-Shan High-Altitude Observatory (near Alma-Ata),and 70-cm reflector in Moscow. In the nights JD 2447289, 2447949, and 2447953 the star PG 0900+401 was monitored continuously during 70 minutes, 210 minutes, and 110 minutes respectively.

The star PG 0900+401 was investigated also on 37 plates obtained with the 40-cm astrograph in Crimea (JD 2434062 - 47973) and on 12 plates obtained with the 10-cm equatorial camera of the Moscow observatory (JD 2417675-19125). The magnitudes of the comparison stars *1-4* were obtained by measuring photographic plates with the iris microphotometer (see the Table).The photographic data obtained on the basis of the rather homogeneous material from the 40-cm astrograph do not show any significant light variability ($B=12^{m}.95-13^{m}.10$). The light variations on the old plates, on the other hand,are between $12^{m}.6-13^{m}.1$ and seem to be due to inhomogeneous photographic material and uncertain photometric system: large errors may arise from an unjustified comparison of the object having a UV excess with an ordinary star.

So, all this looks as absence of any long-term or burst-like activity of the object. The photoelectric photometry of the star PG 0900+401 has not revealed any strong light variability as well. The mean stellar magnitude and color indices of the star from our measurements are as follows: $V=12^{m}.85$, $B-V=+0^{m}.2$, $U-B=-0^{m}.08$, $V-R=+0^{m}.3$, $W-B = -1^{m}.1$.

The power spectrum constructed on the basis of the photoelectric data revealed the periodic light variability with different amplitudes in different filters: $\Delta B = 0^{m}.10$, $\Delta U = 0^{m}.07$, $\Delta V < 0^{m}.05$ (see Fig.2a,b,c).The period of these variations is $P_1=0^{d}.33818$. In principle, the frequency in the power spectrum corresponding to this period has a one-day alias harmonic. The period of these alternative variations is $P_2= 0^{d}.514$. The light curve constructed with this latter period has somewhat greater scatter of the observational points. So, we give a preference to P_1 rather than P_2.

We have discovered also short periodic waves at the U and B light curves in the nights JD 2447289, 2447953 with the period 280 sec. Most significant are the light variations in the B range: $\Delta B \approx$ $\approx 0^{m}.03$ (see Fig.3).

We suggest that the period $0^d.33818$ is the period of the orbital motion of a white dwarf in the close binary system of PG 0900+401.

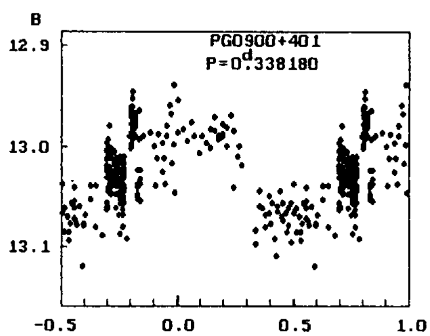


Figure 2a

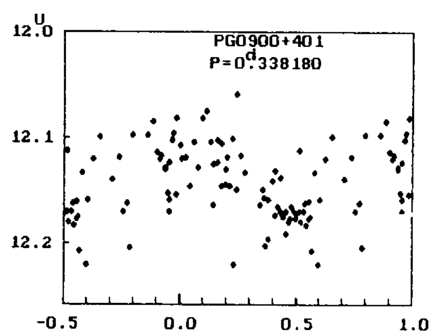


Figure 2b

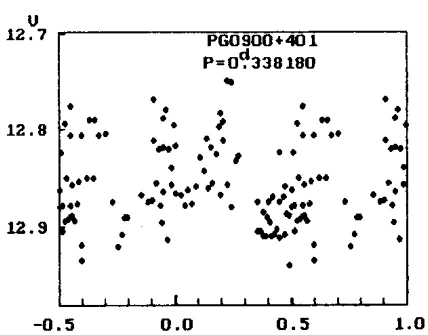


Figure 2c

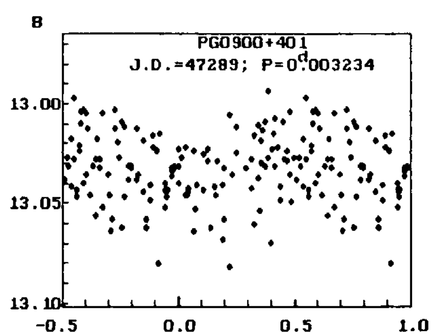


Figure 3

Though we cannot see any eclipses on the light curve due to obscurations of one component by another we do see the light variability connected somehow with the process of the orbital revolution. It may be, for example, explained by periodic appearances of the bright spot on the accretion disk around the white dwarf. If we suppose the masses of the components to be m(K3) $\approx 0{,}7\ M_\odot$, m(WD) $\approx 0{,}8\ M_\odot$, the separation will then be $1{,}8\ R_\odot$.

Since the period 280 sec is much shorter than the orbital one, we can suggest an accretion disk around the white dwarf in this binary system. In this case the white dwarf, an accretor, must be near the equilibrium state which is determined by the equality between the spin-up and spin-down torques in the binary. The equilibrium period can be found from the expression (Lipunov,1987):

$$P_{eq} \approx 100\ L^{-3/7}\ \mu_{32}^{6/7}\ m^{-2/7}\ R_{0,01}^{-3/7}\ \text{sec} \qquad (1)$$

where L is an accretion luminosity of the white dwarf in the units of the solar luminosity; $\mu_{32} = \mu/10^{32}$ G·cm^3, is the magnetic dipole moment; m, the mass of the white dwarf in the solar masses; $R_{0,01}$ = = R/0,01 $R_{\odot}$, the radius of the white dwarf. Substituting the period $P_{eq} \approx 280$ sec, luminosity $L \approx 1\ L_{\odot}$, mass $m \approx 0{,}8\ M_{\odot}$, and radius $R_{0,01} \approx 1$ into the expression (1), we can estimate the strength of the magnetic field at the surface of the white dwarf:

$$B \approx 10^{6}\ L_{\odot}^{1/2}\ P_{100}^{7/6}\ G \approx 3 \cdot 10^{6}\ G \qquad (2)$$

where P_{100} = P/100 sec is the spin period of the white dwarf.Such a magnetic field at the surface of the white dwarf is specific for the intermediate polars. So, it is very important to continue the observations of PG 0900+401 to discover if it is really a new intermediate polar.

In conclusion we would like to thank Dr. V.M.Lipunov for the fruitful discussions concerning the nature of the binary system PG 0900+401 and I.M.Volkov for the help in the observations.

N.A. LIPUNOVA, S.Yu. SHUGAROV

Sternberg Astronomical Institute,
Universitetskij Prosp. 13,
Moscow University, 119899, USSR

References:

Ferguson, D.H. et al.: 1984, Ap. J., 287, 320.
Lipunov, V.M.: 1987, Astrophys. Sp. Sci., 132, 1.
Straizys, V.: 1977, Multicolor Stellar Photometry, Mokslas Publishers, Vilnius.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3581

Konkoly Observatory
Budapest
20 March 1991
HU ISSN 0374 - 0676

OBSERVATIONS OF SUPERNOVA 1989 B

The supernova 1989 B was discovered in NGC 3627 (Evans, 1989). Due to its relative brightness (near 10^m V in maxima) we have tried to use traditional methods for its observations. The observations were obtained during 16 nights in 1989 in Tian-Shan observatory of Sternberg Astronomical Institute with the 19" reflector and a computer controlled WBVR photometer (EMI 9863). The previous processing of these data was reported earlier (Tsvetkov et al., 1990). But later we have obtained more observations and the new method for galaxy flux reduction was used. We have measured the precise position of the supernova from nearby stars and later, when the supernova became invisible, the measurements were repeated with the same diaphragm of 29". So we have obtained the estimation of the galaxy flux in our observa-

Table I. B,V,R data for SN1989 B

JD	B	V	R	B−V	V−R
2447587.273	14.07	12.88	12.03	1.19	0.85
588.412	14.29	12.98	12.10	1.31	0.88
589.408	14.26	13.00	12.11	1.25	0.89
590.369	14.32	13.06	12.09	1.26	0.97
591.350	14.41	13.09	12.13	1.32	0.96
592.398	14.51	13.25	12.23	1.27	1.02
597.372	14.65	13.48	12.61	1.17	0.87
598.345	14.67	13.48	12.55	1.20	0.93
599.416	(15.22)	13.70:	12.75:	-	0.95:
611.170	15.36	14.17	13.48	1.19	0.69
613.209	15.38	14.09	13.54	1.29	0.55
626.327	15.43	14.56	13.80	0.88	0.76
628.367	15.19	14.38	13.68	0.81	0.70
640.163	15.60	14.42	13.72	1.18	0.70
643.181	15.46	14.62	14.09	0.84	0.54
644.264	15.40	14.66	13.89	0.74	0.76

Table II. Ultraviolet data for SN1989 B

JD	W	W-B
2447588.363	14.89	0.60
591.372	14.94	0.62
597.858	14.88	0.21
612.189	15.09	-0.28
627.341	15.61	0.30
642.534	16.11	0.62

tions of supernova. All observations were corrected for atmospheric extinction and reduced to WBVR system using the standard star HD85217 (Khaliullin et al., 1985). The B, V and R magnitudes are given in Table I, where every point is the mean value from 2 to 5 measurements. The mean errors of these data are of the order of $\pm$ $0^m.1$ - $0^m.2$. The counts of our photometer in W (ultraviolet) were too small, and we have to average even measurements from different nights to obtain reasonable values. These data are given in Table II. The mean errors are $\pm$ $0^m.3$ - $0^m.5$. The observations on JD 2447599 were disturbed by an aurora. The galaxy flux in the supernova position corresponds to a G0 V star.

I.M. VOLKOV

Sternberg State's Astronomical Institute
USSR, Moscow, 117899, Universitetsky 13

References:

Evans, R.O.: 1989, IAU Circular, No.4726.
Khaliullin, Kh.F., Mironov, A.V., Moshkalev, V.G.: 1985, Astrophys. Space Sci., 111, 291.
Tsvetkov, D.Yu., Kimeridze, G.N., Volkov, I.M., Bartunov, O.S., Ikonnikova, N.P.: 1990, Astron. Astrophys., 236, 133.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3582

Konkoly Observatory
Budapest
22 March 1991

HU ISSN 0374 - 0676

IS BN Ori STARTING AGAIN?

In this paper we are calling attention of the variable stars observers to the very interesting variable star BN Ori. This star has been classified by the General Catalogue of Variable Stars (Kholopov et al., 1985) as an object belonging to the rapid irregular variables with unpredictable algol-like minima. A serious and complete analysis of main peculiarities in variability of BN Ori has been made by Dragomiretskaya (1965). According to her, the star is characterised by rather prolonged (3000^d + 4000^d) intervals of constant brightness (normal state). These periods are changed by intervals (1000^d ÷ 1500^d in length) of "stormy" photometric activity. But during the last 45 years BN Ori had a constant brightness $V=9^m.63 \pm 0^m.03$ in V (Shevchenko, 1989).

BN Ori has been observed as a part of our current study of irregular variables in the regions of active star formation. All the UBVR observations were obtained with the 0.5 m reflector on the High-Mountain Observational Station "Terskol" (Caucasus, h=3100 m) using a single channel photon counting photometer with an unrefrigerated PRM-79 tube and conventional UBVR filters.

During 38 observational nights 58 observations were obtained. The light curve in V (Figure 1) clearly shows the features observed for irregular variables with non-periodic algol-like minima - i.e. very flat maximum (normal

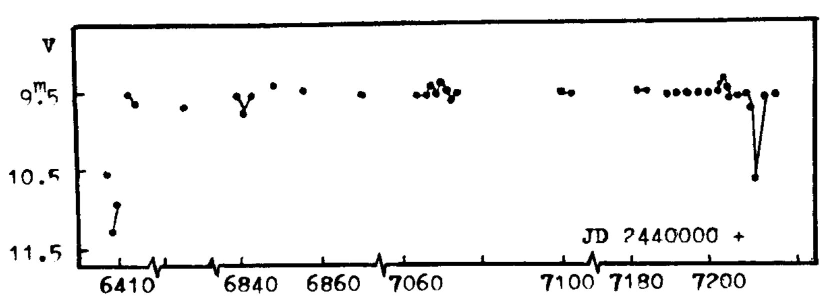


Figure 1

state with $\sigma_V = 0\overset{m}{.}05$) and three light depressions with a maximum amplitude of $\Delta V = 1\overset{m}{.}5$ and maximum duration $\sim 2^d$.

In our opinion, BN Ori is beginning a new period of its "stormy" photometric activity - which has been waited for more than 45 years.

G.U. KOVALCHUCK

Main Astronomical Observatory,
252127, Kiev, Ukrainian SSR

References:

Dragomiretskaya, B.A.: 1965, Astrofizika, 1, 455.

Kholopov, P.N., editor, et al.: 1985, General Catalogue of Variable Stars, Nauka, Moscow.

Shevchenko, V.S.: 1989, Herbig Ae/Be stars, Fan, Tashkent.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3583

Konkoly Observatory
Budapest
22 March 1991

HU ISSN 0374 - 0676

UBV PHOTOMETRY OF THE SYMBIOTIC STAR V1329 Cyg IN 1988-1990

The symbiotic star V1329 Cyg (HBV 475) was discovered by Kohoutek (1969). Since that time many astronomers have observed and made models for this star (Chochol and Vittone, 1986 and references listed by them).

The star was observed photoelectrically from 26 Sep. 1988 to 29 Aug. 1990 with the 1.2 m Kryonerion telescope and a single channel photon counting photometer described by Dapergolas and Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional UBV filters. Its output is fed directly to a microcomputer enabling rapid data access. For the calibration of the photometer the UBV photoelectric equatorial sequences were used (Landolt, 1973).

The period of observations covers $\approx$75% of the phase of V1329 Cyg. The derived mean values are listed in Table I where n indicates the number of observations used for deriving the listed mean value. The phases were calculated using the linear ephemeris $2424869^{d}.9 + 950^{d}.07$ given by Grygar et al. (1979).

The instrumental errors for U,B,V data are $\pm$ 0.1 mag, $\pm$ 0.03 mag and $\pm$ 0.04 mag respectively for 1988 and 1990 and $\pm$ 0.2 mag, $\pm$ 0.05 mag and $\pm$ 0.05 mag respectively for 1989. The calibration error is $\approx$ 0.04 mag.

The derived U magnitudes in Table I show an excess that permits us to suggest the presence of an early type star. This is also confirmed from the B-V colour index that corresponds to a star certainly earlier than M type.

A characteristic feature of the photometric behavior of V1329 Cyg is the presence of fluctuations on the light curve ($\Delta V \approx 1$ mag). These fluctuations were also observed during the pre-flare and after the flare period (Taranova and Yudin, 1986) and confirm that V1329 Cyg is an eclipsing binary.

Table I

Date (JD)	V	B	U	n	Phase
2447431.32	13.16	13.67		5	.747
2447433.27	13.12	13.75	13.3	3	.749
2447435.32	13.14	13.75	13.3	12	.751
2447446.26	13.16	13.76	13.0	2	.763
2447447.25	13.09	13.75	13.1	1	.764
2447448.32	13.13	13.74	13.2	6	.765
2447451.29	13.14	13.78	13.1	3	.768
2447453.28	13.13	13.74	13.2	3	.771
2447454.25	13.15	13.74	13.1	3	.772
2447742.43	14.16	14.78	14.2	5	.074
2447743.49	14.11	14.73	14.1	4	.075
2447745.48	14.10	14.63	14.1	4	.077
2448097.56	13.05	13.64	13.4	5	.448
2448099.52	13.05	13.58	13.3	4	.450
2448124.53	13.12	13.64	13.3	2	.476
2448131.34	13.13	13.66	13.4	4	.484
2448133.32	13.07	13.6	13.3	5	.486

A. DAPERGOLAS and E. KONTIZAS

National Observatory of Athens
Astronomical Institute
P.O. Box 20048
GR Athens 118-10, Greece

M. KONTIZAS

University of Athens
Laboratory of Astrophysics
Panepistimiopolis
GR Athens 151-71, Greece

References:

Chochol, D., Vittone, A.: 1986, Astrophys. Space Sci., 75, 237.
Dapergolas, A., Korakitis, R.: 1987, Publ. Nat. Obs. of Athens, Ser. II, No.28.
Grygar, J., Hric, L., Chochol, D. and Mammano, A.: 1979, Bull. Astron. Inst. Czechosl. 30, 308.
Kohoutek, L.: 1969, I.B.V.S., No.384.
Landolt, A.U.: 1973, Astron. J., 78, 959.
Taranova, O.G., Yudin, B.F.: 1986, Soviet Astronomy, 30, 93.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3584

Konkoly Observatory
Budapest
22 March 1991
HU ISSN 0374 - 0676

LIGHT-CHANGES OF THE CENTRAL STAR OF PLANETARY NEBULA NGC 2346 IN JANUARY 1991*)

NGC 2346 (215+3°1; $AR_{1950} = 7^h06^m49^s.7$, $D_{1950} = -0°43'29"$) is a bipolar planetary nebula the central star of which is known to be a spectroscopic binary with a period of about 16 days (Méndez, Niemela, 1981). The star has shown significant light-changes already in 1982 (see IBVS No. 2113) which belonged to an eclipsing phase between 1981 and 1986 due to a dust cloud (Méndez et al., 1982; Günter, 1990). Within the long-term programme "search for variability of central stars of planetary nebulae" we have observed again in January 1991 changes of the nuclear brightness of NGC 2346 (reported already in IAU Circ.No.5181) having a minimum on JD 2448267.6 ±.15.

Our photoelectric measurements were carried out at the European Southern Observatory, La Silla, Chile, using the 50 cm telescope and a pulse counting photometer (EMI 6256 photomultiplier, diaphragm 21 arcsec). They are summarized in Table I, where n is the number of measurements used; the UBV magnitudes correspond to the central star only, i.e. after subtracting the nebular radiation in the corresponding diaphragms. The nebular brightness was found using measurements in four diaphragms as follows: $V_{neb} = 15^m.10$, $B_{neb} = 13^m.73$, $U_{neb} = 13^m.30$ (standard diaphragm of dia. 21 arcsec). Stars in the E-regions Nos. 2-7 (Cousins, 1973; Vogt et al., 1981) served as photometric standards. Star "b" was used as a local comparison giving $V = 11^m.021$, $B-V = +0^m.360$, $U-B = +0^m.115$ (n=19) nearly identical with the brightness measured before.

We present the V light curve of the star in Fig.1. The depth of the minimum is very small, $\Delta V = 0.09$ mag, $\Delta B = 0.10$ mag, but significant because of the accuracy of our measurements being about ±0.01 mag. The duration of the minimum is about 3-4 days - in the remaining nights the star was nearly constant with the mean magnitudes $V = 11^m.27$, $B-V = +0^m.27$, $U-B = +0^m.28$ which are very similar to those measured from 1987 to 1990.

The decline of the star belongs probably again to the occultation phase due to dust. Further observations will be necessary and some are planned for this year.

---

*) Based on observations collected at the European Southern Observatory, Chile

—

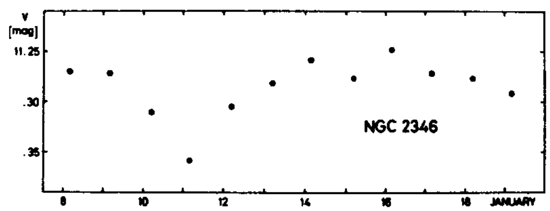


Fig.1 V light curve of the central star of NGC 2346 in January 1991

Table I Photoelectric observations of the central star of NGC 2346 in January 1991

JD 2440000+	V	B−V	U−B	n
8264.66	11.270	+0.288	+0.282	3
8265.67	11.272	0.255	0.272	7
8266.71	11.311	0.299	0.297	2
8267.66	11.358	0.288	0.304	9
8268.69	11.305	0.265	0.283	9
8269.70	11.282	0.281	0.286	8
8270.63	11.259	0.257	0.265	3
8271.69	11.277	0.263	0.266	3
8272.65	11.248	0.275	0.272	3
8273.67	11.272	0.275	0.276	3
8274.68	11.277	0.274	0.286	3
8275.67	11.292	+0.279	+0.289	3

L. KOHOUTEK
Hamburger Sternwarte
D-2050 Hamburg 80
Germany

References:

Cousins, A.W.J.: 1973, Mem. R. Astr. Soc. 77, 223.
Günter, T.: 1990, PhD. Thesis - in preparation
Kohoutek, L.: 1982, I.B.V.S. No.2113.
Kohoutek, L.: 1991, IAU Circ. No.5181.
Mendez, R.H., Gathier, R. and Niemela, V.S.: 1982, Astron. Astrophys., 116, L5.
Mendez, R.H., Niemela, V.S.: 1981, Astrophys. J. 250, 240.
Vogt, N., Geisse, H.S., Rojas, S.: 1981, Astr. Astrophys. Suppl. 46, 7.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3585

Konkoly Observatory
Budapest
4 April 1991
HU ISSN 0374 - 0676

HD 50138: PHOTOMETRIC BEHAVIOR CONNECTED WITH ITS RECENT SHELL EPISODE

Andrillat and Houziaux (1991) have recently observed that the bright Be star HD 50138 (MWC 158) has begun an important new shell phase as of January 1991. They note that an inverted P Cyg profile has developed at the O I λ7773 Å line and that the V/R ratios for the Paschen P9 - 22 lines have changed dramatically from data taken the year before. HD 50138 has been assigned various recent spectral types: e.g., B6 IIIe (Jaschek et al., 1980), B8q[ ] (Allen, 1973) and B9.5 Ve (Gao & Cao, 1984). The star belongs to Jaschek Group I, characterized by permanent Fe II in emission and emission in the Balmer lines to higher terms. Merrill (1931) found a spectroscopic cycle time of about 5 years combined with a shorter one of 330 days from the V/R variations. Doazan (1965) has published a précis of spectrum behavior and found radial velocity and V/R changes to be seemingly periodic over 47 - 52 days with compression and relaxation phenomena occurring as a function of differential velocities within the envelope. The radial velocities for the envelope lines vary with time and for different elements; indeed, the profiles and visibilities of the shell lines can vary over as short a time period as 1 day. Merrill & Lowen (1953) consider that HD 50138 does not possess a typical Be shell because of the rapid changes in the atmospheric motions. [OI] λλ6300, 6363 is also present in the spectrum (Merrill, 1931), making the star similar in some respects to HD 45677 = FS CMa.

HD 50138 has been under photometric observation by the author at the Corralitos Observatory for five of the past six years, during the critical period in which the shell episode began and continuing to the present. Information on the light and color variations of this star is provided herein for investigators who wish to correlate it to spectrum behavior. Differential BV photometry of HD 50138 was performed primarily with the 0.6-m. telescope of the Corralitos Observatory and its single channel photon-counting photometer and ambient temperature EMI 9924A PMT, and secondarily with the Kitt Peak # 2 0.9-m. telescope and cooled 1P21 AFP photometer. Consistency between the telescopes and color systems was excellent: .003 mean magnitudes difference in both V and B-V, a value too small to require correction. Two

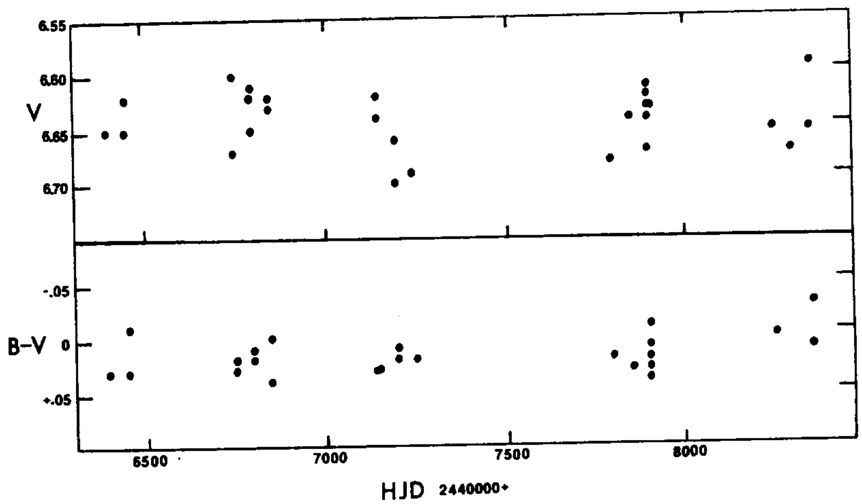


Figure 1: V and B-V for HD 50138

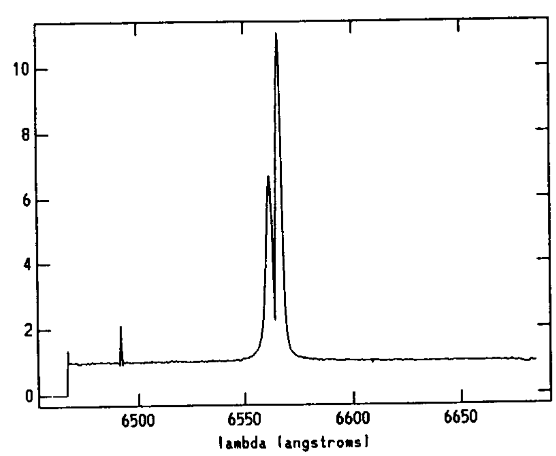


Figure 2: Coudé specrum for HD 50138. The abscissa is in Ångström units, the ordinate in those of the continuum.

TABLE 1: MAGNITUDES FOR HD 50138

HJD (2440000+)	V(SE)	B-V(SE)
6392.8896	6.641(.006)	+.017(.004)
6432.8097	6.611(.001)	-.017(.001)
6457.7392	6.638(.004)	+.016(.006)
6734.9289	6.591(.006)	+.018(.022)
6756.9624	6.660(.025)	+.013(.008)
6776.8578	6.597(.020)	+.014(.002)
6797.7701	6.613(.003)	+.004(.008)
6816.7408	6.636(.013)	+.002(.017)
6832.7993	6.606(.008)	+.027(.001)
6865.6882	6.624(.006)	-.009(.001)
7125.9238	6.633(.009)	+.019(.006)
7170.7910	6.611(.019)	+.018(.004)
7183.7825	6.688(.006)	+.007(.004)
7189.7634	6.647(.012)	+.000(.001)
7232.6666	6.675(.018)	+.007(.016)
7809.9369	6.666(.023)	+.010(.014)
7827.9572	6.627(.008)	+.015(.001)
7878.9039	6.634(.008)	+.014(.011)
7880.8672	6.621(.018)	+.022(.013)
7881.7838	6.609(.006)	+.001(.006)
7896.7868	6.659(.025)	-.017(.014)
7897.7820	6.621(.051)	+.026(.004)
7917.7747	6.600(.019)	+.030(.011)
8243.7511	6.637(.015)	-.006(.004)
8293.7715	6.658(.004)	-----------
8328.6831	6.642(----)	-.038(----)
8330.6271	6.578(.001)	+.003(.054)

comparison stars were utilized: HD 49843 (V = 8.905, B-V = -.049) and HD 49886 (V = 7.610, B-V = -.100). Magnitudes for the comparison stars were obtained from all-sky photometry with the Kitt Peak telescope. Average standard errors for the comparison stars were .015 in V and .013 in B-V.

In all, observations were made on 27 nights over the time period HJD 2446392 - 8330. The values appear in Table I and graphically in Figure 1. Ponomareva (1981) has stated that while HD 50138 was then thought to be non-light variable, the star should begin to vary because of the extreme instability of the envelope. The figure shows this to be the case. HD 50138 is minorly variable in V magnitude about a nearly constant mean magnitude of 6.630 ($\pm$ .027), but probably not in B-V (B-V = + .008 $\pm$ .016). Examination of the magnitudes seasonally revealed no particular trend; the mean magnitudes remained essentially constant within the range of standard errors. The total V range observed was 0.097, in B-V 0.068. Curiously, the new shell episode is invisible in the photometry. Behavior both before and after seems identical.

A single spectrum obtained on JD 2446877 with the coudé feed telescope of the Kitt Peak Observatory and RCA CCD camera is also reproduced herein. The spectrum was centered at Hα and covered a spectral range of 250 Å with resolution 0.89 Å per 2 pixel line width. It was reduced and wavelengths, equivalent widths, emission line widths and intensities were measured via the IRAF operating system resident at Kitt Peak. Appearing in Figure 2, the spectrum shows a strong double emission - central absorption profile at Hα, with V/R = 0.6. λ6678 He I would seem to be visible faintly in absorption in a replot of the spectrum with higher vertical resolution, though not in Figure 2. There are suggestions of other very faint absorption lines, but they were too faint to be measured. The equivalent width for the Hα emission line was found to be 58.4 Å and its radial velocity in the depth of the central absorption, +61.4 km/sec.

HD 50138 will continue to be observed with higher priority at the Corralitos Observatory in the future.

E.M. HALBEDEL

Corralitos Observatory
P.O. Box 16314
Las Cruces, NM
U.S.A. 88004-6314

References:

Allen, D.A.: 1973, MNRAS, 161, 145.
Andrillat, Y. and Houziaux, L.: 1991, IAU Circ. 5164.
Doazan, V.: 1965, Ann. Ap., 28, 1.
Gao, W., Cao, H.: 1984, Publ. Beijing Obs., 6, 33.
Jaschek, M., Hubert-Delplace, A.M., Hubert, H., Jaschek, C.: 1980, AApS, 42, 103.
Merrill, P.: 1931, ApJ, 73, 348.
Merrill, P., Lowen, A.L.: 1953, ApJ, 118, 18.
Ponomareva, G.A.: 1981, Sov. Astr. Let., 7, 228.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3586

Konkoly Observatory
Budapest
4 April 1991

HU ISSN 0374 - 0676

Photometry of two candidates for M67 contact binaries

AG Cnc has been classified as a variable star by Kurochkin (1960; AG Cnc=SVS 1283). Based on 36 photometric measurements derived from photographic plates he concluded that its period of variations is equal to 0.313335 day and that the total amplitude of the light curve is about 0.6 mag. AG Cnc is located in the field of the open cluster M67. According to the results of the proper motion study, it is a highly probable member of the cluster (Sanders 1977; star No. 1113 ;its membership probability is 96 per cent). Kurochkin (1960) suggested that AG Cnc belongs to dwarf cepheids. However, its period and an absolute magnitude (derived under the assumption that it is a M67 member) suggest that it may be a short period eclipsing binary. M67 is known to possess at least three W UMa-type systems: AH Cnc (Kurochkin 1960; Efremov et al. 1964) and two systems discovered recently by Gilliland et al. (1991).

The star IV-25 (designation according to Eggen and Sandage 1964) is located in the central region of M67 and its proper motion indicates that it is a cluster member (Sanders 1977; star No. 1063; its membership probability is 93 per cent). Racine (1971) concluded from the comparison of his photographic photometry and photoelectric photometry published by Eggen and Sandage (1964) that the brightness of IV-25 varies by at least 0.18 magnitude. On the other hand, Frolov (1983) failed to detect any evidence for a variabilty of IV-25 on six photographic plates. Results of the recent proper motion study of M67 by Girard et al. (1989) also support membership of AG Cnc and IV-25 to M67. They derived membership probabilities 97% and 98% for IV-25 and AG Cnc respectively.

To clarify the questions concerning the nature of AG Cnc and IV-25 we collected a CCD photometry of these stars. Observations were performed using a #1 0.9-m telescope of the Kitt Peak National

Table 1
BV photometry of AG Cnc. Phases are calculated for a period 0.31333 d and for an arbitrary ephemeris.

JDhel 244 6700+	B	V	Phase
74.044	14.849	13.782	0.142
75.987	-	13.766	0.340
75.989	14.831	13.788	0.346
76.052	14.853	-	0.549
76.055	14.848	13.803	0.558
78.055	14.871	13.758	0.941
78.055	14.855		0.940
78.890	14.863	-	0.607
79.019	14.899	13.837	0.016
79.046	14.895	13.847	0.103
79.816	14.834	13.785	0.561
80.061	14.850	13.777	0.343

Observatory. During the period between Dec. 9 and Dec. 15 1986 we collected 11 B and 9 V frames of the 7.3x4.6 arcmin field centered on AG Cnc. The obtained photometric data are given in Table 1. The transformation to the standard BV system was based on the observations of several stars from the central part of M67. The standard error of an individual measurement is about 0.015. We phased our observations with a period of 0.313335 day and concluded that AG Cnc hardly exhibits any large amplitude variability with the quoted period. However, there is a strong evidence that on the frames collected on Dec. 14 the star was by about 0.05 mag fainter than during the remaining measurements (it is worthy to point out that this weakening was observed in both filters). The area covered by our frames contains 17 stars with B>17. None of these stars, with an exception of AG Cnc, exhibited a variability with a full amplitude exceeding 0.040 mag.

Our photometry of IV-25 is given in Table 2. On the frames collected on Dec 9, the star was by about 0.10 magnitude fainter than during the remaining observations.

In Figure 1 we show a color-magnitude diagram for a part of a central region of M67 with the marked positions of AG Cnc and IV-25. Both stars are located 2 magnitudes above the cluster main sequence in the same area of the diagram. Their colors are too red and their magnitudes are too faint as for a star from the M67 subgiant

Table 2
BV photometry of M67 star IV-25

JDhel 244 6700+	B	V
74.042	14.599	13.582
74.048	14.589	13.579
75.981	14.529	-
76.056	14.531	13.518
78.054	14.503	13.498
78.891	14.504	13.523
79.022	14.520	13.499
79.047	14.491	13.493
79.8170	14.483	13.485
80.060	14.480	13.488

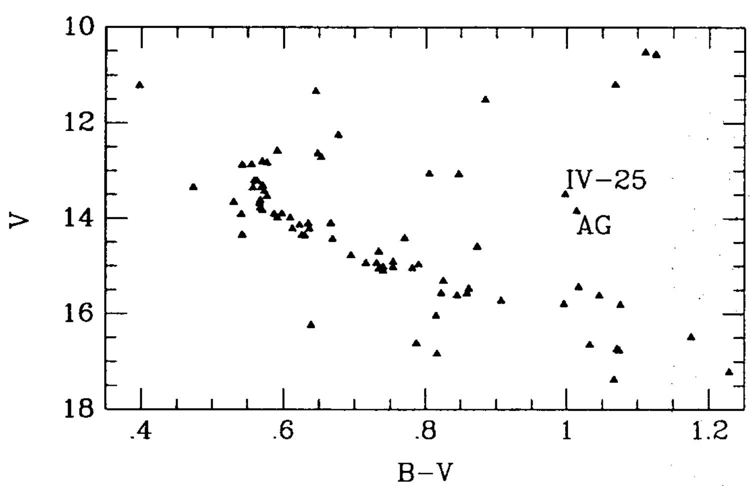


Figure 1 - Color-magnitude diagram for a subset of M67 stars with the positions of AG Cnc and IV-25 indicated.

branch (for more complete color-magnitude diagram see Racine, 1971). Concluding, our photometry supports claims about variability of AG Cnc and IV-25. At the same time it rules out large amplitude variations of AG Cnc with the period of about 8 hours. The nature of variability of both stars remains unknown. The strange positions of both stars on the color magnitude diagram of M67 support the hypothesis about a binary nature of AG Cnc and

IV-25. We note that, two M67 contact binaries identified recently by Gilliland et al. (1991) possess light curves whose full amplitudes do not exceed 0.15 mag. We suggest that AG Cnc and IV-25 are highly evolved W UMa-type binaries with extremely small mass ratios and consequently small amplitudes of light variations.

J. Kałużny[1] and J. Radczyńska
Warsaw University Observatory
Al. Ujazdowskie 4
00-478 Warszawa, Poland

[1] Visiting Observer, Kitt Peak National Observatory, National Optical Astronomy Observatories, operated by the Association of Universities for Research in Astronomy, Inc., under contract with the NSF.

References:

Efremov, Y.N., Khopolov, P.N., Kukarkin, B.V., and Sharov, A.S. 1964, Inf. Bull. Var. Stars., No. 75.

Eggen, O.J., and Sandage, A.R., 1964, Astrophys. J., 140, 130.

Frolov, V.N. 1983, Astron. Circular USSR, No.1280, 2.

Gilliland, R., Brown, T.M., Duncan D.K., Suntzeff, N.B., Lockwood, G.W., Thompson, D.T., Schild, R.E., Jeffrey, W.A., Penprase, B.E., 1991, Astron. J., February issue, in print.

Girard, T.M., Gundy, W.M., Lopez, C.E, van Altena, W.F., 1989, Astron. J., 98, 227.

Kurochkin, N.E. 1960, Astron. Circular USSR, No. 212, 9.

Racine, R. 1971, Astrophys. J., 168, 393.

Sanders, W.L. 1977, Astron. Astrophys. Supp., 27, 89.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3587

Konkoly Observatory
Budapest
5 April 1991

HU ISSN 0374 - 0676

BV OBSERVATIONS OF THE OCT. 1990 ECLIPSE OF 22 Vul

INTRODUCTION

Zeta Aurigae eclipsing binaries consist of a K or M giant and a B main sequence star. Around the times of the eclipse contacts, the B star shines through the outer atmosphere and inner stellar wind of the giant, producing absorption features. Because the B star is small, these binaries offer a unique opportunity to spatially resolve the density, velocity structure, composition, and ionization state of the near environment of the giant star.

Unfortunately, the typically large orbits mean that orbital inclinations must lie quite close to 90^{o} for there to be eclipses, and the frequency of the eclipses will be low. There are presently only 9 such systems known; Zeta Aurigae itself, Epsilon Aurigae, VV Cep, 31 and 32 Cyg, and four recent discoveries; Tau Persei (Ake, et al. 1986), HR 6902 (Griffin and Griffin, 1986), HR 2554 (Ake and Parsons, 1987), and 22 Vul (Parsons and Ake, 1983). The number is expected to grow with the ongoing systematic search conducted by the Griffins (Griffin, et al. 1990).

22 Vul was discovered to be a Zeta Aurigae system in 1983 (Parsons and Ake 1983) and is especially interesting, having the latest hot component (B9) and the earliest cool component (G3 Ib-II) of the class, as well as the shortest period (249 days). Ake, Parsons, and Kondo (1985) performed a preliminary analysis of the star, and found some uncertainties which could be clarified by more photometry. For example, combined ground-based and IUE fluxes are difficult to fit with a standard color and the standard reddening law. Also, the hot component is quite faint and only an upper limit on its luminosity class is known. While mass transfer effects appear not to be important, the UV spectrum is similar to some interacting binaries, and P Cygni-type line profiles show the entire region surrounding the stars is filled with a cool gas. It may be that 22 Vul is in the brief phase before or after the supercritical mass flow stage presently observed in Beta Lyrae (Ake, Parsons, and Kondo 1985).

In order to make further progress, the relative sizes, shapes, brightnesses, and positioning of the stars must be measured more accurately. This requires good photometry, especially around the time of the eclipse contacts. Towards this end, Cabrillo Observatory undertook BVR observations of 22 Vul during its October 1990 primary eclipse.

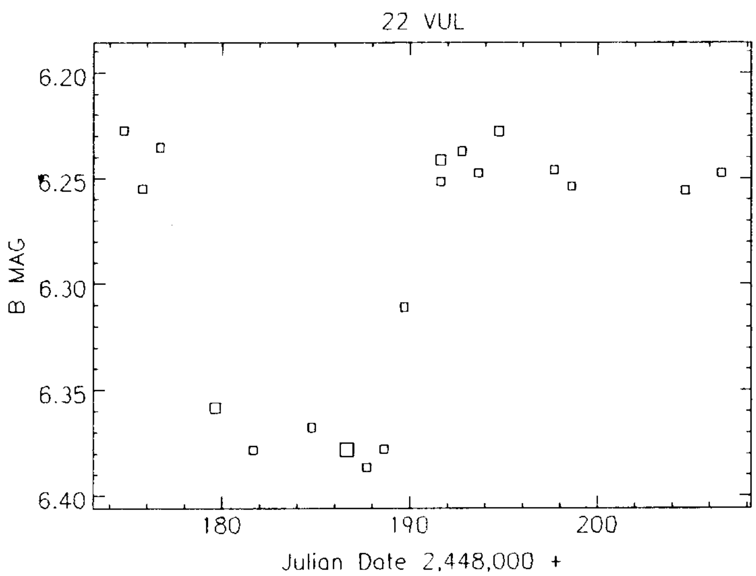


Figure 1. Differential B magnitude relative to 24 Vul

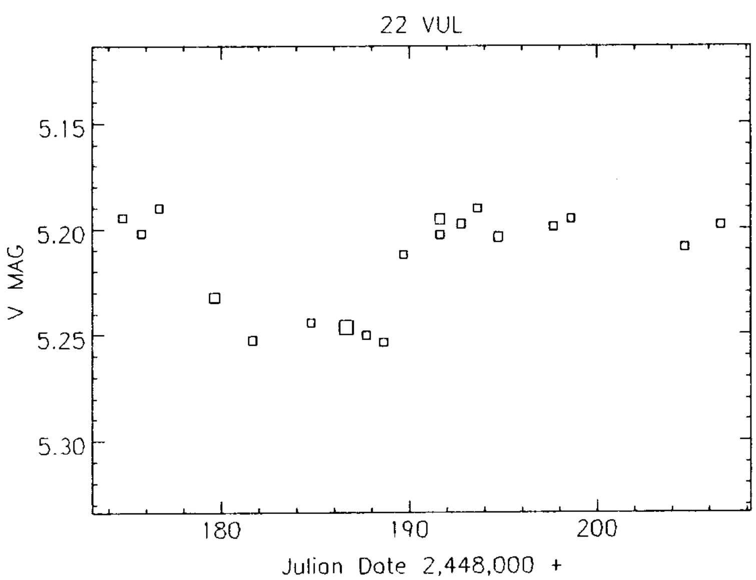


Figure 2. Differential V magnitude relative to 24 Vul

Table 1. V and B-V magnitudes for each observation

Hel. JD	JD(V)	V	JD(B-V)	B-V
2448174+	0.72053	5.195	0.72010	1.040
2448174+	0.72233	5.197	0.72206	1.018
2448174+	0.72485	5.192	0.72453	1.040
2448175+	0.71624	5.194	0.71596	1.061
2448175+	0.71834	5.204	0.71799	1.057
2448175+	0.72042	5.208	0.72013	1.041
2448176+	0.67280	5.194	0.67231	1.037
2448176+	0.67525	5.191	0.67485	1.042
2448176+	0.67763	5.185	0.67727	1.057
2448179+	0.63339	5.217	0.63306	1.149
2448179+	0.63514	5.232	0.63486	1.109
2448179+	0.63720	5.248	0.63691	1.120
2448179+	0.63339	5.217	0.63306	1.149
2448179+	0.63514	5.232	0.63486	1.109
2448179+	0.63720	5.248	0.63691	1.120
2448181+	0.63889	5.247	0.63853	1.138
2448181+	0.64069	5.252	0.64043	1.110
2448181+	0.64287	5.251	0.64249	1.132
2448181+	0.65001	5.249	0.64975	1.127
2448181+	0.65194	5.264	0.65162	1.121
2448184+	0.76111	5.249	0.76081	1.125
2448184+	0.76355	5.239	0.76313	1.134
2448184+	0.76551	5.245	0.76521	1.111
2448186+	0.64076	5.251	0.64049	1.131
2448186+	0.64285	5.248	0.64256	1.133
2448186+	0.64472	5.251	0.64439	1.124
2448186+	0.65139	5.249	0.65110	1.128
2448186+	0.65341	5.253	0.65304	1.119
2448186+	0.65524	5.228	0.65494	1.153
2448186+	0.64076	5.251	0.64049	1.131
2448186+	0.64285	5.248	0.64256	1.133
2448186+	0.64472	5.251	0.64439	1.124
2448186+	0.65139	5.249	0.65110	1.128
2448186+	0.65341	5.253	0.65304	1.119
2448186+	0.65524	5.228	0.65494	1.153
2448187+	0.69576	5.245	0.69530	1.150
2448187+	0.69715	5.244	0.69681	1.139
2448187+	0.69866	5.255	0.69826	1.137
2448187+	0.70005	5.258	0.69970	1.119
2448187+	0.70144	5.250	0.70111	1.135
2448188+	0.62083	5.245	0.62057	1.138
2448188+	0.62208	5.255	0.62181	1.122
2448188+	0.62492	5.252	0.62464	1.124
2448188+	0.62617	5.253	0.62590	1.125
2448188+	0.62743	5.263	0.62715	1.112
2448189+	0.68757	5.225	0.68715	1.111
2448189+	0.68925	5.210	0.68883	1.099
2448189+	0.69071	5.207	0.69035	1.104
2448189+	0.69212	5.212	0.69174	1.088
2448189+	0.69362	5.207	0.69319	1.091
2448191+	0.62045	5.208	0.62016	1.030
2448191+	0.62484	5.190	0.62456	1.060
2448191+	0.62604	5.186	0.62573	1.044
2448191+	0.63108	5.188	0.63079	1.044
2448191+	0.63404	5.201	0.63376	1.045
2448191+	0.63970	5.200	0.63942	1.052
2448191+	0.64091	5.198	0.64063	1.052
2448191+	0.64645	5.199	0.64611	1.061
2448191+	0.64770	5.212	0.64740	1.033
2448192+	0.76366	5.188	0.76339	1.052
2448192+	0.76498	5.197	0.76472	1.055
2448192+	0.77013	5.199	0.76986	1.039
2448192+	0.77141	5.207	0.77115	1.012
2448193+	0.63126	5.195	0.63100	1.035
2448193+	0.63249	5.187	0.63222	1.045
2448193+	0.63561	5.196	0.63536	1.076
2448193+	0.63794	5.184	0.63767	1.072
2448194+	0.73278	5.205	0.73204	0.992
2448194+	0.73398	5.195	0.73372	1.040
2448194+	0.73530	5.201	0.73501	1.043
2448194+	0.74000	5.199	0.73973	1.034
2448194+	0.74131	5.201	0.74102	1.041
2448194+	0.74259	5.223	0.74230	0.996
2448194+	0.74411	5.203	0.74383	1.021
2448197+	0.66649	5.197	0.66583	1.078
2448197+	0.66815	5.204	0.66767	1.043
2448197+	0.67016	5.204	0.66949	1.037
2448197+	0.67292	5.198	0.67234	1.041
2448197+	0.67525	5.193	0.67464	1.035
2448198+	0.60889	5.197	0.60844	1.047
2448198+	0.61036	5.196	0.61005	1.064
2448198+	0.61191	5.201	0.61161	1.043
2448198+	0.61321	5.193	0.61291	1.068
2448198+	0.61450	5.190	0.61424	1.070
2448204+	0.67745	5.207	0.67705	1.060
2448204+	0.67920	5.202	0.67874	1.064
2448204+	0.68117	5.212	0.68078	1.042
2448204+	0.68257	5.218	0.68228	1.022
2448204+	0.68477	5.204	0.68404	1.048
2448206+	0.60213	5.200	0.60184	1.049
2448206+	0.60350	5.199	0.60314	1.049
2448206+	0.60487	5.196	0.60455	1.050

OBSERVATIONS

Cabrillo College Observatory has a .25m Schmidt-Cassegrain with a PC controlling an Optec SSP-3A photometer equipped with Johnson-Cousins BVRI filters. We use the RPHOT data acquisition and reduction software package (Nolthenius 1990). Each clear night in October and early November 1990, the star was observed with the following sequence; sky - comparison - variable - variable - variable - comparison - sky. Each night, from three to 12 observations were made of the variable star. Each observation consisted of 4 to 8 consecutive 10-second integrations in each of the filters B, V, and R. The comparison star was 24 Vul = HR 7753. Figure 1 shows the light curve in B, with each night's data averaged to a single point. Unfortunately, most of the critical periods of ingress and egress were spoiled by clouds. Figure 2 shows the V light curve. All magnitudes are differential with respect to 24 Vul, whose B=5.32 and B-V=0.95. Table 1 shows the V and B-V for each observation.

RESULTS

The eclipse depth is 0.150 ± 0.007 in B, and 0.051 ± 0.007 in V; in good agreement with the Parsons, Ake, and Hopkins (1985) values of 0.136 and 0.052, respectively. From the single ingress and egress observations, the time of mid-eclipse is found to be JD 2448184.94 ±.1. Combining this with the well-observed eclipse of August 1984 (Parsons, Ake, and Hopkins 1985) gives a photometric period of 249.1828 ±.01 days. The duration of totality is not well determined, but is at least 8.8 days, and less than 10.0 days, with no significant difference between the durations in B and V.

With this further refinement in the photometric period, it should be possible to better target the brief and critical partial phases during subsequent eclipses.

RICHARD NOLTHENIUS
Dept. of Astronomy
Cabrillo College
Aptos, CA 95003
email ucscc\!cabuucp\!rickn

REFERENCES

Ake, T. B., Barksdale, W. S., Fried, R. E., Hopkins, J. L., Fekel, F. C., Hall, D. S., Landis, H. J., and Louth, H., 1986, **Inf. Bull. Var. Stars No. 2847**

Ake, T. B., and Parsons, S. B., 1987, **Inf. Bull. Var. Stars No. 3002**

Ake, T. B., Parsons, S. B., and Kondo, Y., 1985, **Ap. J. 298**, 772

Griffin, R. E. M., Griffin, R. F., Schroder, K.-P., and Reimers, D., 1990, **Astron. Astrophys. 234**, 284

Griffin, R. and Griffin, R., 1986, **J. Astrophys. Astron. 7**, 195

Parsons, S. B., and Ake, T. B., 1983, **Inf. Bull. Var. Stars No. 2334**

Parsons, S. B., Ake, T. B., and Hopkins, J. L., 1985, **P.A.S.P. 97**,, 725

Nolthenius, R. A., 1990, in **"Proceedings of the Conference on Robotic Observatories"**, Astronomical Society of the Pacific, Conference Series, Boston Univ., Fairborn Press

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3588

Konkoly Observatory
Budapest
16 April 1991
HU ISSN 0374 - 0676

VARIABLE STARS IN THE IRAS POINT SOURCE CATALOGUE

The five-volume Point Source Catalogue of infrared sources resulting from the work of the Joint IRAS Science Working Group (see Beichman *et al* 1988) contains excellent infrared photometric data and quite accurate positions for over 245,000 astronomical objects. This extremely valuable catalogue is accompanied in many cases by "associations" or possible identifications of the included objects, based almost entirely on positional coincidence. As would be expected, numerous named and suspected variables are contained in the catalogue. The purpose of this note is simply to point out that not all of these variables are so identified. This is not surprising, as it was never intended. There are at least three reasons for the lack of identification of many variables. (1) Many catalogues besides the GCVS and the 1982 New Catalogue of Suspected Variable Stars were used to establish the associations, and only a single association is cited. Many of the brighter variables, thus, are identified only by reference to such catalogues as the Smithsonian Astrophysical Observatory, the Dearborn Red Star, or the Caltech Two-Micron Survey catalogues. (2) The version of the GCVS used included only those named variables so designated by the year 1970, and thus the variables in later naming lists are not noted. And (3) the tabulated positions of many variables are quite inaccurate, and positional associations are often uncertain or impossible.

The extent to which the Point Source Catalogue does not identify named variables is difficult to estimate. In Scorpius it appears that about 20% of them are not so designated, while in the more northerly constellations such as Aries or Boötes the fraction is much larger. It is thus apparent that researchers seeking infrared photometric data for variable stars should check the catalogue positions directly instead of relying on the associations given, which are still useful, of course, for other purposes.

WILLIAM P. BIDELMAN
Warner & Swasey Observatory
Case Western Reserve University
Cleveland, Ohio 44106

Reference:

Beichman, C. A., Neugebauer, G., Habing, M. J., Clegg, P. E., and Chester, T. J. 1988, *Infrared Astronomical Satellite (IRAS) Catalogs and Atlases* (Washington: NASA Ref. Publ. 1190).

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3589

Konkoly Observatory
Budapest
17 April 1991

HU ISSN 0374 -0676

HD 12545: A RECORD PHOTOMETRIC AMPLITUDE FOR AN RS CVn STAR

INTRODUCTION

HD 12545 = SAO 55233 = BD +34°363 is a 7th magnitude G5IV single-line spectroscopic binary star which shows RS CVn-type light variations. Bidelman (1985) initially identified the star as a good candidate to study for RS CVn behavior based on objective prism spectra showing remarkably strong H and K ionized calcium emission. Hall added the star to his list of suspected variables (Fekel and Hall 1985), and 16 observations by Ingvarsson and Milton between August 1986 and April 1987 showed a large but not unusual range of 0.16 magnitude in V (Hooten and Hall 1990), and a best fit photometric period 5% longer than the 23.9 day orbital period (Strassmeier, et al. 1988).

OBSERVATIONS

The star was added to the observing program at Cabrillo College Observatory because of the unusual strength of the H and K emission and the small amount of follow-up photometry. The observatory has a 0.25m f/10 Schmidt-Cassegrain equipped with an SSP-3A photometer and BVRI filters. The data were taken and reduced with the RPHOT software package. Differential magnitudes in Johnson/Cousins BVRI are relative to Bidelman's suggested comparison star of HD 12478 = SAO 55221, spectral type K0.

Observations between early September 1990 and late December 1990 show the classic RS CVn pattern (higher amplitude at short wavelengths, progressively less at longer wavelengths where the cooler spot contributes more light) but with a remarkable amplitude of 0.8 magnitude in B, 0.6 in V, 0.5 in R, and 0.4 in I. Figure 1 shows the V observations. An observation consisted of of four 10-second integrations bracketed by the comparison star and sky. Typically 2 to 5 such data points were obtained each night. The typical internal dispersion in these readings is ±.05 magnitude, leading to an estimated uncertainty of .03 magnitude in the plotted points. Assuming the variability is due entirely to spots, this is the largest observed amplitude in a spotted star so far (Hall, 1991). The highest previous star-spot amplitude until now was 0.50 in V for II Peg in late 1986 (Doyle, et al. 1988)

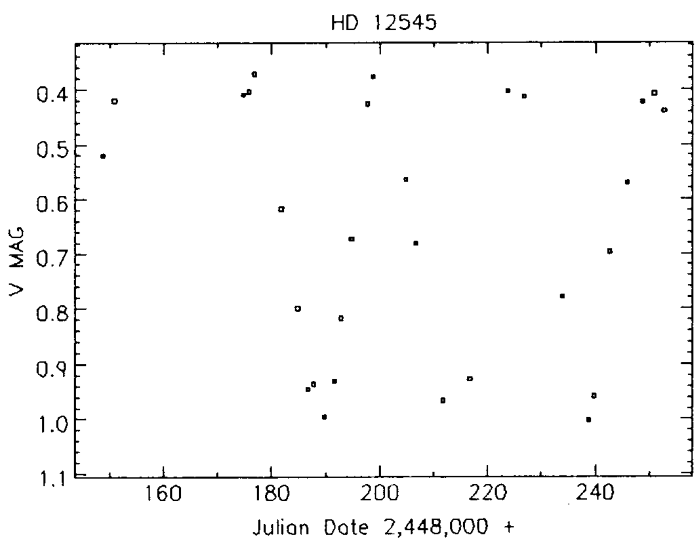


Figure 1: Differential Johnson V magnitudes smoothed over each night, from September through December 1990. Larger squares average more observations. Included are parts of 5 cycles.

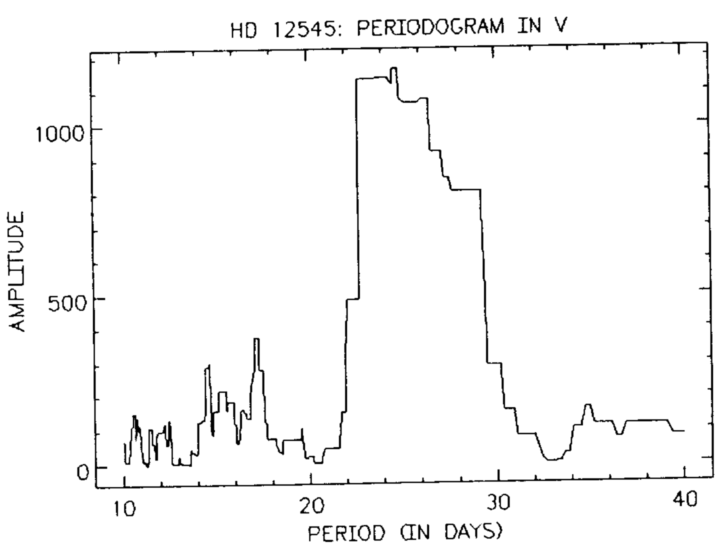


Figure 2: Jurkevich periodogram of the Figure 1 data. Synchronous rotation (P=23.9 days) cannot be ruled out, but a 24.4 day period is a better fit to this data. Hall (Strassmeier, et al. 1988) found 25.1 days for 1986 data.

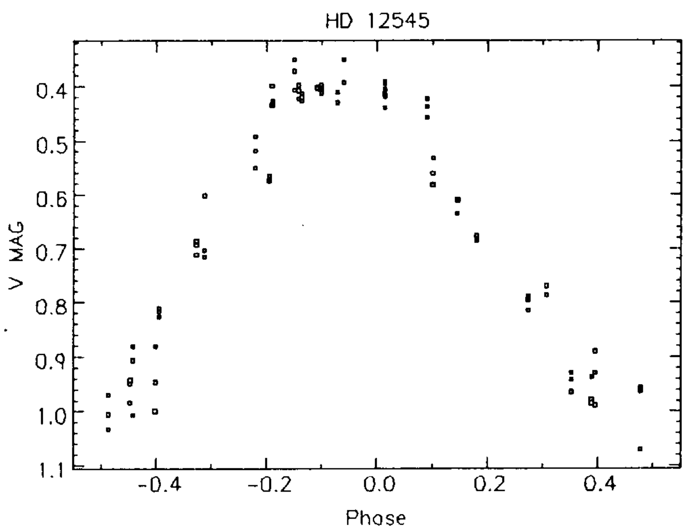


Figure 3: Folded phase plot of the unsmoothed full data set, assuming a period of 24.4 days. The 5 day flat spot at maximum indicates the spot(s) occupy less than 180 degrees of longitude.

INTERPRETATION

A Jurkevich period analysis in V (Figure 2) gives a broad maximum to the Jurkevich index between 23.9 and 26.1 days, and is similar in the other bands. More careful replottings of the full data set on folded phase plots using a range of periods in this interval showed that the best period was 24.4 ± .1 days in all filters. Figure 3 shows the results in V. While 23.94 days is an excellent fit to the V data when the data is smoothed over a night, the unsmoothed data is better fit with 24.4 days. Using the unsmoothed data is preferred since this allows the night-to-night variations to be compared to the internal dispersion in each night's data.

The present observations lead to a number of questions. The large, nearly sinusoidal variation suggests a large spot centered at low stellar latitude with a rotation axis inclined very roughly perpendicular to the line of sight. If the orbital plane is similarly inclined there is a reasonable chance for eclipses. However, there is as yet no obvious evidence for eclipses in the light curves. The folded phase plot (using an assumed period of 24.4 days) of Figure 3 shows a short interval (approximately 5 days) of constant light near maximum, showing the spot(s) occupy less than 180 degrees of longitude. Ellipticity may contribute some part to the photometric variations if the large radius is an appreciable fraction of the Roche radius. However, the low photometric amplitude seen 4 years ago argues that this effect must be small. As pointed out by Hooten and Hall (1990), the v sin i of 17 km/sec together with his assumed 25-day rotation period implies a minimum radius of 8.4 solar radii, making the luminosity classification of IV suspiciously low. Unfortunately, Doppler image analysis of the spot(s) will not be productive, given the low v sin i.

The exaggerated behavior of this star offers a chance to study the RS CVn phenomenon in greater detail. One important question is the relation of asynchronous rotation to the formation of star spots. For this it is important to get photometry over a longer baseline, permitting a firmer photometric period to be established. The presently determined photometric period is not significantly different from the orbital period. Also, new spectroscopy is also needed to see if the dramatically increased photometric variation is accompanied by stronger H and K emission.

Hall and Henry have new photometry on this object, using the Vanderbilt 16-inch APT on Mt. Hopkins, partially overlapping the observations presented here. A preliminary look at these data confirms the Figure 1 light curve. A more complete set of combined observations and analysis will be presented later (Nolthenius, Hall, and Henry 1991).

ACKNOWLEDGMENTS

I thank Karl Von Ahnen for expert telescope assistance during some of these observations, and to Doug Hall for helpful conversations and a reading of the manuscript.

Richard Nolthenius
Dept. of Astronomy
Cabrillo College
Aptos, CA 95003
email UCSCC\!CABUUCP\!RICKN

REFERENCES

Bidelman, W. P., 1985, **I.A.P.P.P. Comm. No. 21**, 53.

Doyle, J. G., Butler, C. J., Morrison, L. V., and Gibbs, P., 1988 **Astr. Astrophys. 192**, 275.

Fekel, F. C., and Hall, D. S., 1985, **I.A.P.P.P. Comm. No. 20**, 37.

Hall, D. S., 1991, **I.A.U. Colloq. No. 130**, in press.

Hooten, J. T., and Hall, D. S., 1990, **Ap. J. Suppl. 74**, 225.

Strassmeier, K. G., Hall, D. S., Zeilik, M., Nelson, E., Eker, Z., and Fekel, F. C., 1988, **Astr. Ap. Suppl. 72**, 291.

Nolthenius, R. A., Hall, D. S., and Henry, G. W. 1991, **Astron. J.**, in preparation.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3590

Konkoly Observatory
Budapest
17 April 1991

HU ISSN 0374 - 0676

THE PULSATION AMPLITUDE OF DELTA CETI

δ Ceti (HR 779, HD 16482) is a classical, no-frills, singly-periodic β Cephei variable. Its one claim to fame rests on the well-observed secular changes in its period and velocity amplitude. These have been documented and discussed in detail by a number of authors (Lloyd & Pike, 1984; Jerzykiewicz et al., 1988). Lloyd & Pike emphasized the requirement for consistent monitoring of this object with the hope that a substantial database of observations, built up over many years, would aid in the understanding of this, one of the purest β Cephei variables.

In this spirit, Kubiak and Seggewiss (1990) have recently reported an analysis of observations from the 1986 observing window. From their spectroscopic data they present the striking result that the observed pulsation velocity amplitude was nearly twice that previously observed and well in excess of that expected from the ephemeris calculated by Lloyd & Pike. The purpose of this note is to present the results of some spectroscopic observations taken by the authors rather fortuitously only some three months before the Kubiak & Seggewiss data and to reiterate, before the next observing season, the need for further observations of this star. Full details of our spectral observations together with some further photometry will be published elsewhere. The spectra reported on here were obtained very early in the 1986 season and as a result do not cover a full pulsation cycle. However, given the accuracy with which the period is known, the amplitude can be estimated accurately enough from the available phase coverage.

Our spectra were obtained at the Cassegrain focus of the Isaac Newton Telescope at the Spanish observatory of El Roque de los Muchachos, La Palma using a GEC CCD as detector and a grating giving a reciprocal dispersion of 7.6 A/mm. The spectra were centred at 4580A so that each exposure included nine sharp lines of Si III, O II and N II. The velocities derived are given in Table I. The observed values have been corrected for the Earth's motion but not for any instrumental zero point. The average standard error of the mean velocity of each spectrum is 0.8 km/s. The results are plotted in Figure 1 where they have been overlayed with a fitted least-squares sinusoid of period 0.161137 days. The derived semi-amplitude

Table I

Radial Velocities of HR 779

HJD+ 2446639	km/s	HJD+ 2446639	km/s
.64604	14.8	.70126	2.5
.64971	13.7	.70423	2.5
.65337	12.8	.70718	2.8
.65726	11.7	.71015	3.3
.66381	9.4	.71315	3.4
.66815	7.5	.71894	4.2
.67110	7.3	.72194	5.4
.67408	6.0	.72493	5.9
.67708	4.8	.72790	6.2
.68004	4.6	.73090	6.5
.68633	3.6	.73715	8.7
.68930	3.3	.74013	10.0
.69226	2.5	.74309	10.2
.69523	2.3	.74619	11.9
		.74918	12.8

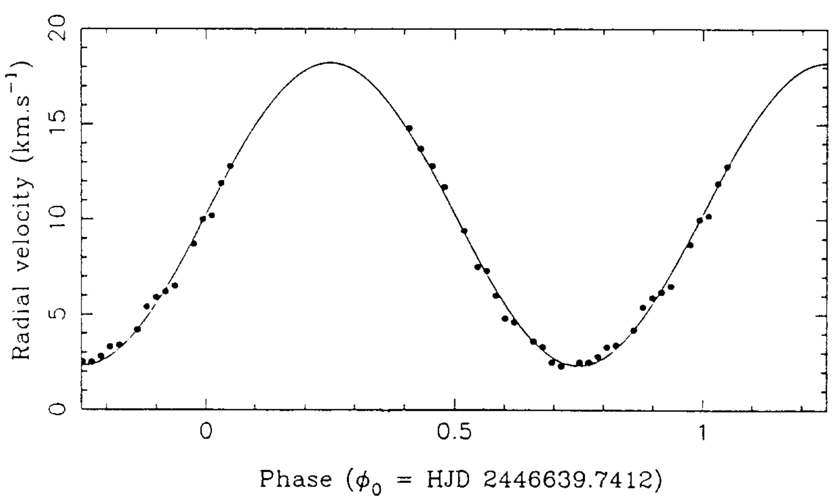


Figure 1

is K = 7.95 +/- 0.10 km/s. This compares favourably with the value of K = 8.1 km/s predicted by the amplitude ephemeris of Lloyd & Pike (1984). The time of velocity maximum is HJD 2446639.7815 +/- .0002 which has an (O-C) of +0.02 days from the Lloyd & Pike ephemeris and +0.01 days from the more recent ephemeris of Kubiak & Seggewiss. We also note that our new photometry is also consistent with previous photometry and ephemerides.

If the result of Kubiak & Seggewiss represents a real amplitude increase it must have been rather sudden. Its duration is unknown but the solution to that may lie in some, as yet, unreduced data since we note that the average time between acquisition and publication of new data on this star is about 5 years! In any case it provides, yet again, an illustration of the value of systematic monitoring and lest we forget..... another 5 years has passed!

C.D.Pike & C. Lloyd
Rutherford Appleton Laboratory
Chilton,
Didcot,
Oxon, OX11 0QX
UK.

References:

Jerzykiewicz, M., Sterken, C. & Kubiak, M., A. & A. Suppl. 72, 449, 1988.
Kubiak, M. & Seggewiss, W., Acta Astronomica, 40, 85, 1990.
Lloyd, C. & Pike, C.D. The Observatory, 104, 9, 1984.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3591

Konkoly Observatory
Budapest
18 April 1991
HU ISSN 0374 - 0676

ON THE NEW ERUPTIVE OBJECT IN LIBRA

Debehogne (1990) reported on the discovery of a new eruptive object in Libra at the position $15^h07^m31^s.10$, $-1^\circ44'01''.7$ (1950.0), which appears bright on the sheets of the POSS, but faint 14^m ... 16^m on other atlasses and on archival plates.

Three plates of the Sonneberg Sky Patrol (Ernostar camera) were taken by P. Ahnert at the European evenings just before and after the Palomar plates were exposed. On these exposures the object is invisible (⌒). Thus the following table for the blue magnitudes of the star during the time of the eruption can be made up:

1955 Apr.	19	22^{26} UT	⌒ $> 14^m.0$	Ernostar 10502
	20	8^{05}	11.2	POSS 0-1402
	20	23^{58}	⌒ > 12.5	Ernostar 10510
	21	23^{45}	⌒ > 14.0	Ernostar 10516

Our magnitude scale has been linked to the M5 sequence of Arp (1955; 1962), stars A, B, D, and E. The brightness on POSS 0-1402 is confirmed by a comparison with BD $-3^\circ3746$ on POSS 0-1431, made with the help of several stars in common on both sheets: The variable is noticeably fainter than the BD star, the U, B, V data of which were given by Corben et al. (1972) and Roman (1955) and have been compiled by Mermilliod and Nicolet (1977): $V = 9^m.85$, $B = 10^m.99$.

Nova type and long-cycle dwarf nova variability can be excluded by the short duration of the eruption (≤ 1 day) and the small amplitude. The fact, however, that the object is invisible on most of the 470 suitable Sonneberg Sky Patrol plates taken mainly by P. Ahnert, H. Huth and B. Fuhrmann in the years 1929 to 1990 and barely detectable as a faint trace of 14^m on the rest, but never in strong further eruptions, speaks against an SS Cygni type. It is not a minor planet, as can be seen by blink comparison of the plates of 1955 Apr. 19 and 21.

The red magnitude on POSS E-1402 is roughly $10^{m}.7$ - linking to the V sequence of Arp (l.c.) and taking into account the conversion formula of Van den Bergh (1957).

I thank Mrs. A. Wicklein for inspecting most of the plates.

W. WENZEL
Sternwarte Sonneberg
Zentralinstitut für Astrophysik
Deutschland

References:

Arp, H.C., 1955, Astron. J. 60,p.1
Arp, H.C., 1962, Astrophys. J. 135,p.311
Corben, P.M., et al., 1972, Mon. Notes Astron. Soc. South Africa 31,p.8
Debehogne, H., 1990, IAU Circ. 5131
Mermilliod, J.C., Nicolet, B., 1977, A General Catalogue of UBV Photoelectric Photometry, Centre de Données Stellaires, Strasbourg
Roman, N.G., 1955, Astrophys.J. Suppl. Ser. 2,p.195
Van den Bergh, S., 1957, Astron. J. 62,p.100

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3592

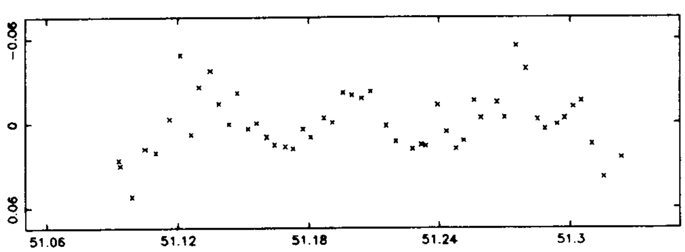
Konkoly Observatory
Budapest
19 April 1991

HU ISSN 0374 - 0676

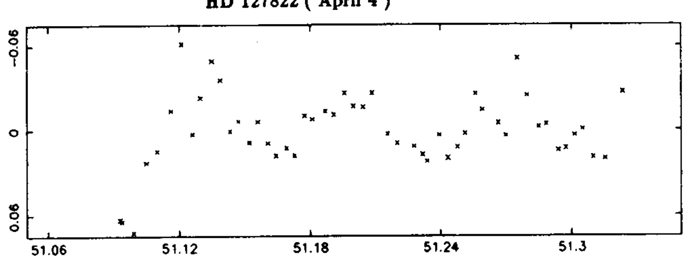
HD 127759: A NEW DELTA SCUTI VARIABLE

Photometric photometry of HR 5437 (SAO 016411), HD 127759 (SAO 016405), HD 127411 (SAO 016394) and HD 127822 (SAO 016408) was obtained between 1991 March 22 and April 8. The spectral types of these stars are in the range of A0 to F5. The 60 cm reflector at Xinglong Station of Beijing Astronomical Observatory China together with a photometer in DC mode (Shi et al., 1987) was used. Observations were made through a standard Johnson V filter.

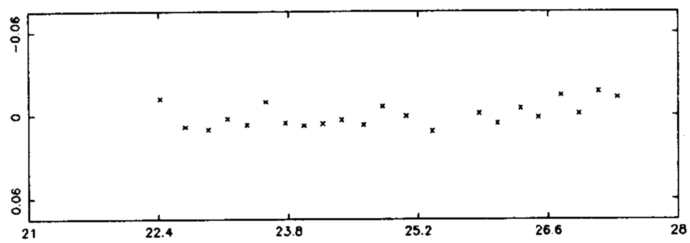
On the night of 1991 April 4, we observed HR 5437, HD 127759, HD 127411 and HD 127822 for six hours. The differential analysis shows that the light curves of HD 127759 relative to both HD 127822 and HD 127411 tend to show the same variation. The period of variation is about $1\overset{h}{.}6$ with an amplitude of $0\overset{m}{.}06$, these features can be seen from Figures 1 and 2. The light curve



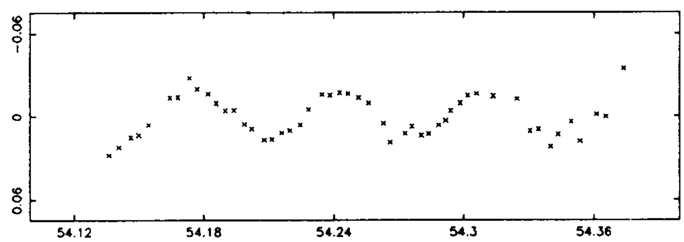
Epoch (HJD 2448300. +)
Fig. 1 The light curve of HD 127759 relative to HD 127822 (April 4)



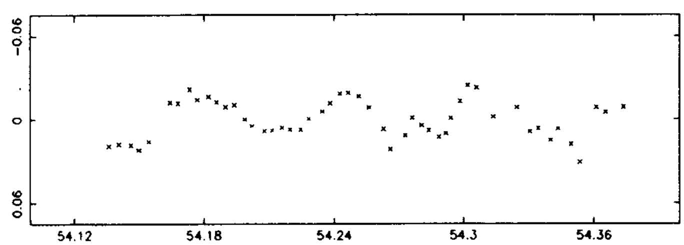
Epoch (HJD 2448300. +)
Fig. 2 The light curve of HD 127759 relative to HD 127411 (April 4)



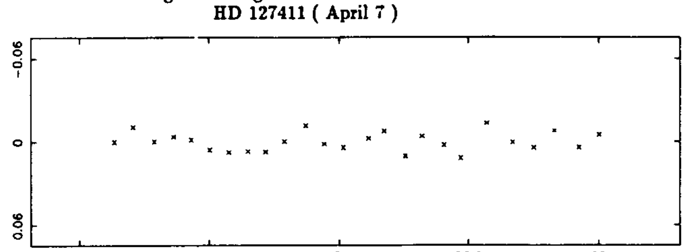
Epoch (The Beijing Times)
Fig. 3 The differential curve of HD 127411 − HD 127822 (April 4)



Epoch (HJD 2448300. +)
Fig. 4 The light curve of HD 127759 relative to HD 127822 (April 7)



Epoch (HJD 2448300. +)
Fig. 5 The light curve of HD 127759 relative to HD 127411 (April 7)



Epoch (The Beijing Times)
Fig. 6 The differential curve of HD 127411 − HD 127822 (April 7)

of HD 127759 relative to HR 5437 also supports this result. HD 127411 and HD 127822 seem to be stable within an error of = $0^{m}.009$, its differential curve shows a random variation (see Figure 3).

The above results were confirmed by the observations made on the night of April 7. During six hours of observations, the differential light curves, no matter which of HD 127411 or HD 127822 was used as comparison, both show the same periodic variation which cover three cycles as presented in Figures 4 and 5. The period and amplitude are the same as that of April 4 basically. Figure 6 shows the magnitude differences between HD 127882 and HD 127411 which is constant within $0^{m}.015$ and gives = $0^{m}.0074$ during this night. So the observations of April 4 and 7 both show the same result, and the choice of either HD 127822 or HD 127411 as comparison does not affect the basic feature of the light variation in HD 127759.

The spectral type of HD 127759 is F0, in accordance with the spectral range of delta Scuti variables. Its period and amplitude are in agreement with that of known delta Scuti variables. So we tend to classify it to be a delta Scuti type variable with a visual magnitude of $8^{m}.41$.

LI ZHIPING[1], JIANG SHIYANG[1], LIU YIANGYIN[1], CAO MING[2]

[1] Beijing Astronomical Observatory, Academia Sinica, Beijing, China, 100080

[2] Shaanxi Astronomical Observatory, Academia Sinica, Lintong, China, 710600

Reference:

Shi, C.M., Du, B.T. et al.: 1987, Acta Astrophysica, 7, 230.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3593

Konkoly Observatory
Budapest
22 April 1991
HU ISSN 0374 - 0676

Epochs of Minimum Light For Eight Eclipsing Binary Star Systems

An Optec SSP-3 photometer was used on the 41cm David Irons telescope at the observatory of the Charlotte Amateur Astronomers Club to make differential measurements of eight eclipsing binaries. Because of the sensitivity of the detector and the faintness and color of the stars, generally only V observations were attempted. The exception is R Canis Majoris, for which both B and V observations were made. The Hertzsprung method was used to find epochs of minimum light, which are presented in Table I. The epoch of R Canis Majoris is an average of the determinations from the observations in each filter.

The residual for AA Andromedae was computed based on the light elements of Pierce (1951). Because the residual was about 1.86 hours, a new set of light elements was obtained by combining this epoch of minimum light with those from recent literature:

$$\text{H.J.D. MIN.I} = \underset{\pm 13 \text{ p.e.}}{2447804.6739} + \underset{\pm 36 \text{ p.e.}}{0^{d}.93509705}\,E$$

Note that this period is about 0.289 seconds shorter than that of Pierce. Table II contains the epochs of minimum light used to get the above light elements, as well as the residuals. Photoelectric epochs of minimum light were weighted by a factor of five in the computations.

The residual for AO Camelopardalis was computed based on the light elements of Evans *et al.* (1985). The insignificance of the residual indicates that the period of AO Camelopardalis has remained constant.

The residual for WY Cancri was calculated based on the light elements of Mullis and Faulkner (1988). Mullis and Faulkner presented two times of minimum light that indicated the period had decreased. A time of minimum light presented by Mullis and Faulkner (1989) along with the time of minimum light presented here supports the new period of Mullis and Faulkner (1988).

The residual for R Canis Majoris was computed from the light elements of *S.A.C.* No. 61 (1990). Since the residual was about 48.5 minutes, a new set of light elements was calculated by combining this epoch of minimum with those from recent literature.:

$$\text{H.J.D. MIN.I} = 2447918.7189 + 1^{d}.13595100E$$
$$\pm 25 \text{ p.e.} \qquad \pm 258 \text{ p.e.}$$

Note that this period is about 1.037 seconds longer than that of *S.A.C.* No. 61. The epochs of minimum light used to get the above light elements, as well as the residuals, are shown in Table III. Photoelectric epochs of minimum light were weighted by a factor of five in the computations.

The residuals for SW Lacertae were determined from the light elements of Faulkner *et al.* (1984). The period of SW Lacertae has apparently remained constant because the residuals presented here are very small.

The residuals for XY Leonis were determined from the light elements of Kaluzny and Pojmánski (1982). Because the residuals were about 35 minutes, a new set of light elements was obtained by combining these epochs of minimum light with those from recent literature:

$$\text{H.J.D. MIN.I} = 2447864.9125 + 0^{d}.28409949E$$
$$\pm 18 \text{ p.e.} \qquad \pm 27 \text{ p.e.}$$

Note that this period is 0.219 seconds longer than that of Kaluzny and Pojmánski. The epochs of minimum light used to get the above light elements, as well as the residuals, are given in Table IV. A period change apparently occurred between -4900 and 0 cycles. This explains the large probable errors exhibited by the new light elements presented here. Note the systematic differences between the O-C's for primary and secondary eclipses which indicate a displaced secondary. Faulkner and Grossoehme (1983) noted this, but it was first noted by Gehlich *et al.* (1972).

The residual for AM Leonis was computed based on the light elements of Rafert and Twigg (1980). Since the residuals for AM Leonis presented by Mullis and Faulkner in 1989 and here are relatively small, it can be deduced that the period of AM Leonis had remained constant since the observations of Rafert and Twigg.

The residual for GR Tauri was determined from the light elements of Yamasaki *et al.* (1984). Because their observations only spanned 81 cycles, we attempted to improve the period, using our epoch of minimum light and those of Yamasaki *et al.*:

$$\text{H.J.D. MIN.I} = 2444573.1070 + 0^{d}.42985160E$$
$$\pm 2 \text{ p.e.} \qquad \pm 7 \text{ p.e.}$$

This refined period is only approximately 0.0778 seconds shorter than the period of Yamasaki *et al.* Table V contains the epochs of minimum light used to get the above light elements.

Table I
Epochs of Minimum Light

Star	Hel. J.D.	E	(O-C)
AA Andromedae	2447804.6670	19168.0	-0.0775
AO Camelopardalis	2447864.7879	6423.5	+0.0025
WY Cancri	2447971.6029	2346.0	-0.0004
R Canis Majoris	2447918.7210	22790.0	+0.0337
SW Lacertae	2447821.5405	6968.0	+0.0007
"	2447822.6617	6971.5	-0.0006
"	2447825.7092	6981.0	+0.0001
"	2447850.5649	7058.5	+0.0000
"	2447854.5747	7071.0	+0.0008
"	2447860.5080	7089.5	+0.0008
XY Leonis	2447864.9146	9822.0	+0.0237
"	2447881.8187	9881.5	+0.0240
AM Leonis	2447971.7479	4978.5	-0.0003
GR Tauri	2447881.6752	7697.0	-0.0066

Table II
AA Andromedae

Hel. J.D.	E	(O-C)	Source
2439033.448	-9380.0	-0.0155	*H.B.Z.* No. 76 (1987)
2441598.443	-6637.0	+0.0082	"
2441599.376	-6636.0	+0.0061	"
2441600.308	-6635.0	+0.0030	"
2441959.374	-6251.0	-0.0082	"
2441960.324	-6250.0	+0.0067	"
2447060.3455	-796.0	+0.0089	*B.A.V. Mitt.* No. 50 (1988)
2447804.6670	0.0	-0.0073	This paper
2448209.5689	433.0	-0.0020	Faulkner (1991)

Table III
R Canis Majoris

Hel. J.D.	E	(O-C)	Source
2445743.384	-1915.0	+0.0113	*B.A.V. Mitt.* No. 43 (1986)
2445743.378	-1915.0	+0.0053	" No. 48 (1988)
2446521.493	-1230.0	-0.0061	" No. 52 (1989)
2446536.247	-1217.0	-0.0195	*B.B.S.A.G.* No. 82 (1987)
2447205.330	-628.0	-0.0116	*B.A.V. Mitt.* No. 50 (1989)
2447230.345	-606.0	+0.0124	*B.B.S.A.G.* No. 88 (1988)
2447581.339	-297.0	-0.0024	" No. 91 (1989)
2447918.7210	0.0	+0.0021	This paper

Table IV
XY Leonis

Hel. J.D.	E	(O-C)	Source
2445396.6566	-8688.0	+0.0005	Faulkner/Grossoehme (1983)
2445416.6904	-8617.5	+0.0053	"
2445444.6685	-8519.0	-0.0004	"
2445449.6462	-8501.5	+0.0025	"
2445732.8868	-7504.5	-0.0011	Faulkner (1986)
2446079.9122	-6283.0	-0.0032	"
2446469.4080	-4912.0	-0.0078	Pohl *et al.* (1987)
2447864.9146	0.0	+0.0021	This paper
2447881.8187	59.5	+0.0023	"

Table V
GR Tauri

Hel. J.D.	E	(O-C)	Source
2444544.3075	-67.0	+0.0006	Yamasaki *et al.* (1984)
2444573.1074	0.0	+0.0004	"
2444578.2643	12.0	-0.0009	"
2444579.1252	14.0	+0.0003	"
2446438.6622	4340.0	-0.0007	Faulkner (1986)
2447881.6752	7697.0	+0.0004	This paper

CHRISTOPHER R. MULLIS
Astronomy Department
University of Virginia
Charlottesville, VA 22903-2475
U. S. A.

DANNY R. FAULKNER
University of South Carolina-
Lancaster
Lancaster, SC 29720
U. S. A.

References:
Evans, E.E., Grossoehme, D.H., and Moyer, E.J. 1985, *Pub.A.S.P.*, 97, 648.
Faulkner, D.R. 1986, *Pub.A.S.P.*, 98, 605.
———, 1991, private communication.
Faulkner, D.R., and Grossoehme, D.H. 1983, *Inf.Bull.Var.Stars*, No. 2335.
Faulkner, D.R., Evans, E.E., Grossoehme, D.H., and Moyer, E.J. 1984, *Inf.Bull.Var.Stars*, No. 2473.
Gehlich, U.K., Prolss, J., and Wehmeyer R. 1972, Astr. and Astrophy. 18, 477.
Kałuzny, J., and Pojmánski, G. 1982, *Inf.Bull.Var.Stars*, No. 2181.
Mullis, C.R., and Faulkner, D.R. 1988, *Inf.Bull.Var.Stars*, No. 3206.
———, 1989, *Inf.Bull.Var.Stars*, No. 3354.
Pierce, N.L. 1951, *Princeton Contr.*, 25, 9.
Pohl, E., Akan, M.C., Ibanoglu, C., Sezer, C., and Güdür, N. 1987, *Inf.Bull.Var.Stars*, No. 3078.
Rafert, J.B. and Twigg, L.W. 1980, *Mon.Not.R.A.S.*, 193, 79.
Yamasaki, A., Okazaki, A., and Kitamura, M. 1984, *Pub.Astro.Soc.Japan*, 36, 175.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3594

Konkoly Observatory
Budapest
25 April 1991

HU ISSN 0374 - 0676

PHOTOMETRIC VARIABLE STARS FOUND IN FIVE SOUTHERN OPEN CLUSTERS

During the years 1985 to 1989 we have been carrying out photoelectric UBV observations of the following five southern open clusters : NGC 2437, NGC 2453, NGC 2539, Cr 223 and NGC 5749. These clusters were selected for observation because they have either not been previously observed photoelectrically or the existing data are far from being complete. The results of these photometric studies are being prepared for publication.

The aim of this note is to report the variability detected in twenty one stars in the region of the above mentioned clusters. Finding charts for the variable stars in NGC 2539, Cr 223 and NGC 5749 are shown in Figures 1 to 3. The new variables found in the field of NGC 2437 and NGC 2453 are shown in the finding charts published by Cuffey (1941) and Moffat and Fitzgerald (1974).

A total of 567 stars were observed in the UBV system in the field of these clusters. The measurements were performed during several observing runs with the 0.6 m, 0.9 m and 1.0 m telescopes of the Cerro Tololo Inter-American Observatory (CTIO), the 0.6 m Canadian telescope of the David Dunlap Observatory located in Las Campanas Observatory (LCO) and the 2.15 m telescope of the Complejo Astronómico El Leoncito (CASLEO) located in San Juan (Argentine). Dry-ice cooled RCA 31034A and 1P21 photomultipliers were used in these observatories with pulse-counting equipments and standard UBV filters. Mean coefficients were employed in LCO and CTIO to correct for atmospheric extinction, whereas the coefficients published by

Table 1 : Mean errors of the UBV photometry.

	External mean errors		
	ε_V	ε_{BV}	ε_{UB}
0.6 m (LCO)	0.009	0.006	0.011
0.6 m (CTIO)	0.012	0.009	0.009
0.9 m (CTIO)	0.011	0.005	0.013
1.0 m (CTIO)	0.008	0.009	0.010
2.15 m (CASLEO)	0.013	0.012	0.013

		Internal mean errors		
		σ_V	σ_{BV}	σ_{UB}
0.6 m (LCO)	$V \leq 12.0$	0.017	0.014	0.018
	$V > 12.0$	0.023	0.026	0.028
0.6 m (CTIO)	$V \leq 12.0$	0.015	0.014	0.016
	$V > 12.0$	0.018	0.022	0.026
0.9 m (CTIO)	$V \leq 12.0$	0.010	0.009	0.016
	$V > 12.0$	0.014	0.016	0.024
1.0 m (CTIO)	$V \leq 12.0$	0.013	0.012	0.011
	$12.0 < V \leq 13.0$	0.015	0.012	0.019
	$V > 13.0$	0.022	0.022	0.023
2.15 m (CASLEO)	$V \leq 12.0$	0.016	0.017	0.019
	$12.0 < V \leq 13.0$	0.021	0.019	0.022
	$V > 13.0$	0.022	0.024	0.029

Minniti et al. (1989) were used to reduce the CASLEO observations. The UBV standard system was established by nightly observing between 11 and 18 standard stars selected from the lists of Cousins (1967, 1973, 1974) and Graham (1982). The external (ε) and internal (σ) mean errors of the UBV photometry are summarized in Table 1.As shown

Table 2 : Individual UBV observations of new variable stars found in southern open clusters.

STAR	V	B-V	U-B	Sp. Type	Membership
		NGC 2437 (Cuffei 1941)			
174	10.640	1.110	0.882	K	pm
	10.727	0.964	0.869		
		NGC 2453 (Moffat and Fitzgerald 1974)			
50	10.519	2.037	1.756	K3II/Ib	m
	10.740	2.003	1.200		
		NGC 2539 (Clariá et al. 1991)			
1	12.793	0.540	-0.074	?	nm
	12.618	0.588	-0.195		
	12.630	0.615	0.044		
2	13.172	0.570	-0.116	F5	pm
	13.274	0.402	-0.038		
3	11.804	0.166	0.153	A3/5	m
	11.921	0.130	0.160		
	11.860	0.144	0.135		
4	13.504	0.155	-0.114	?	nm
	13.375	0.495	0.055		
5	13.348	0.392	0.000	F2	m
	13.315	0.409	0.136		
	13.427	0.373	0.096		
6	11.648	0.909	0.399	?	nm
	11.993	0.289	0.117		
	11.765	0.933	0.646		
7	13.016	0.298	0.192	A5/7	m
	12.206	0.187	0.165		
8	13.393	0.366	-0.078	F0	m
	13.504	0.330	0.110		
9	13.580	1.301	0.919	K	nm
	13.749	1.332	1.416		
10	12.432	0.305	0.087	F0	pm
	12.948	0.431	0.026		
	12.971	0.333	0.099		
11	12.954	0.384	0.074	F0/5	m
	14.179	0.486	-0.005		

Table 2 (continued)

	Cr 223 (Clariá and Lapasset 1991)				
10	12.629	0.772	0.250	G5	nm
	12.734	0.855	0.347		
	12.681	0.820	0.299		
41	12.716	0.168	-0.130	B8V	m
	13.054	0.136	-0.087		
42	12.709	1.660	1.736	G5/8	nm
	12.478	0.921	0.575		
105	11.683	0.105	-0.308	B6V	m
	11.781	0.054	-0.325		
	11.843	0.013	-0.357		
109	13.442	0.433	0.292	A7/9	nm
	13.668	0.426	0.197		
	NGC 5749 (Clariá et al. 1991)				
40	12.497	1.512	-	K4III	nm
	12.640	1.401	1.217		
64	12.972	0.444	0.276	B9V	m
	13.086	0.390	0.247		
	12.991	0.416	0.232		
82	13.051	0.413	0.247	B9V	pm
	13.736	0.689	0.339		

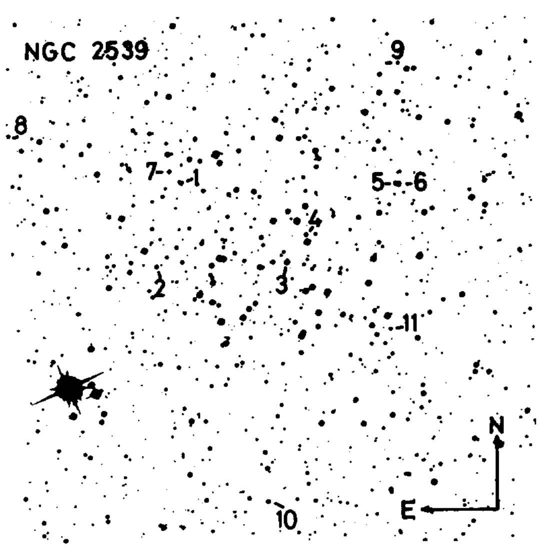


Figure 1 : Finding chart for the variables found in NGC 2539.

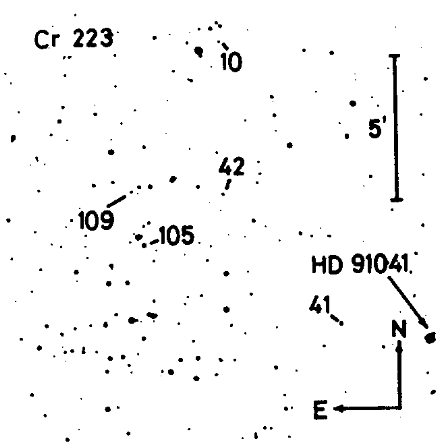


Figure 2 : Finding chart for the variables found in Cr 223.

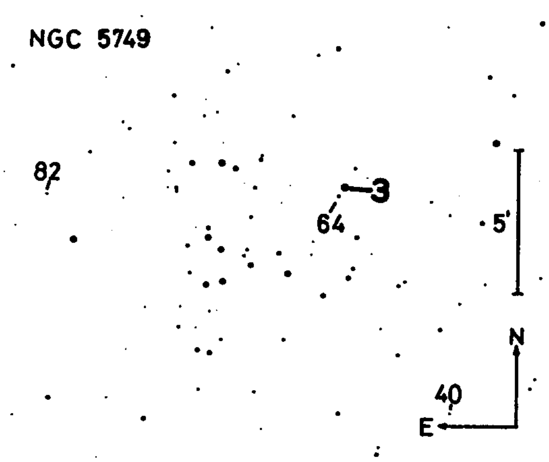


Figure 3 : Finding chart for the variables found in NGC 5749.

in this table, the mean external errors ε are all about 0.01 mag, independently of the telescope used. On the other hand, the mean internal errors σ_V , deduced from the night-to-night dispersion of the program stars, is about 0.02 mag, practically independent of the

V-magnitude and telescope used. There exists, however, a small increase in σ_{BV} and σ_{UB} with the V-magnitude.

We have considered a star to be a photometric variable when its individual V measures during different nights displayed variations greater than five times the mean internal error, i.e., $\Delta V > 0.1$ mag. To discern whether a star is a member (m), probable member (pm) or non-member (nm), we have applied two membership criteria described by Clariá and Lapasset (1986). The probable membership of the red variable stars in the field of NGC 2437 and NGC 2453 was evaluated from combined UBV and DDO (still unpublished) data by applying the criteria described by Clariá and Lapasset (1983). Among the new variables detected there are thirteen which are found to be members or probable members of the studied clusters (Clariá and Lapasset 1991, Clariá et al. 1991),whereas the remaining eight stars are very likely field stars. Four of the new variables exhibit ΔV variations greater than 0.50 mag, five show ΔV values between 0.20 mag and 0.50 mag, and the remaining twelve stars have ΔV variations in the interval 0.09 mag $< \Delta V <$ 0.20 mag.

The individual UBV measurements of the new variables are shown in Table 2. The references for star identifications are given at the head of each section of the table. Column (5) lists the spectral type as estimated from the UBV colours, excepting for stars of NGC 2437 and NGC 2453 wherein the MK spectral types were deduced from the unreddened DDO colours (Clariá et al. 1991). The last column of Table 2 indicates if the star is believed to be a cluster member, probable member or non-member field star.

We are very indebted to staff members and night assistants of CTIO, LCO, and CASLEO for the alloted observing runs and kind hospitality. Thanks are also due to J. E. Laborde and B. Candellero for the preparation of figures. This work was partially supported by CONICET and CONICOR of Argentine.

E. LAPASSET,[*] J.J. CLARIÁ[**,***]

Observatorio Astronómico, Universidad Nacional de Córdoba, Argentina

and

D. MINNITI[***]

Steward Observatory, University of Arizona, USA.

[*] Visiting astronomer, University of Toronto (David Dunlap Observatory) 24-inch telescope at Las Campanas Observatory.

[**] Visiting astronomer of Cerro Tololo Inter-American Observatory supported by the National Science Foundation under contract No. AST 74-04128.

[***] Visiting astronomer of Complejo Astronómico El Leoncito (CASLEO), Argentine.

References

Clariá, J.J. and Lapasset, E. 1983, J. Astrophys. Astron. 4, 117.

Clariá, J.J. and Lapasset, E. 1986, Astron. J. 91, 326.

Clariá, J.J. and Lapasset, E. 1991, Pub. A. S. P. (submitted).

Clariá, J.J., Lapasset, E. and Minniti, D. 1991 (in preparation).

Cousins, A.W.J. 1967, Mon. Not. Astron. Soc. S. Africa 26, 151.

Cousins, A.W.J., 1973, Mem. Roy. Astron. Soc. 77, 223.

Cousins, A.W.J., 1974, Mon. Not. Astron. Soc. S. Africa 33, 149.

Cuffei, J., 1941, Astrophys. J. 94, 55.

Graham, J.A. 1982, Pub. A. S. P. 94, 244.

Minniti, D., Clariá, J.J. and Gómez, M.N., 1989, Astrophys. Space Sci. 158, 9.

Moffat, A.F.J. and Fitzgerald, M.P. 1974, Astron. Astrophys. suppl. 18, 19.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3595

Konkoly Observatory
Budapest
26 April 1991
HU ISSN 0374 - 0676

ON THE TWO-COMPONENT STRUCTURE OF SPECTRUM-FORMING LAYER OF METALS IN CEPHEID T Vul

Based upon the system of equivalent widths for determining the local temperature in physical variable stars (Fenina et al., 1990) an investigation of the classical cepheid T Vul ($P=4^{d}.4315578$) was carried out from the equivalent widths published in the work by Rautela et al. (1981). In their work some physical and chemical parameters of stars were determined in different phases of light variations by the method of differential "curves-of-growth" with respect to the Sun. The authors account their choice of the comparison star for the closeness of T Vul spectral class (F7 Ib -G3 Ib) to the solar one. However the equivalent widths of absorption lines of metals, in particular neutral iron, when compared to the stationary stars of the same spectral classes using similar dispersion, are not always consistent with their spectral interval. In a number of cases the equivalent widths of FeI absorption lines are inconsistent with temperature parameters determined by the authors (Rautela et al., 1981). Besides the temperature parameters and the spectral classes interval of T Vul given in their work are inconsistent with each other. Therefore the alternative analysis was made of equivalent widths of absorption lines in T Vul by the absolute method of "curves-of-growth" with the account of local temperature and new data on atomic parameters of chemical elements. The excitation temperature was determined by the method of successive approximations from the local temperature determination. In the first approximation the temperature is estimated from each of the lines from the work by Fenina et al. (1990).

In constructing "the curves-of-growth" with the individual value Θ_{ex} for each line it is divided into two components (Fig. 1) from which one can estimate two dominant mean values Θ_{ex} as the second approximation. Within the range of these values, as a rule, there is the value Θ_{ex}, parameter Θ_{ex} determined by Rautela et al., (1983). Two phases of the main light variation $\phi= 0.04$ and 0.72 are exceptions. The division of the curve of

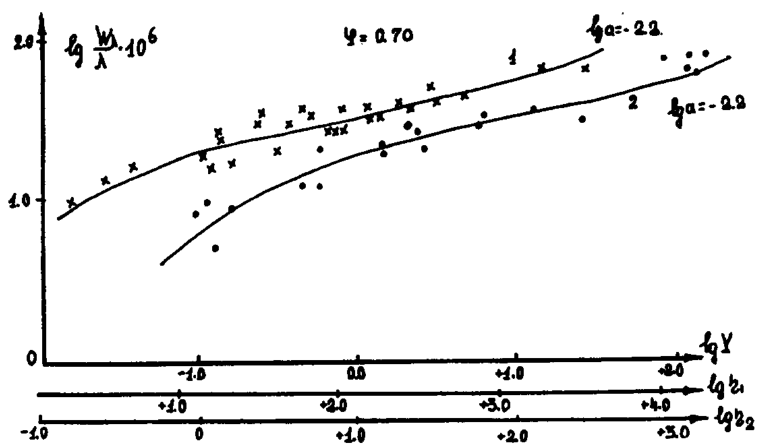


Figure 1

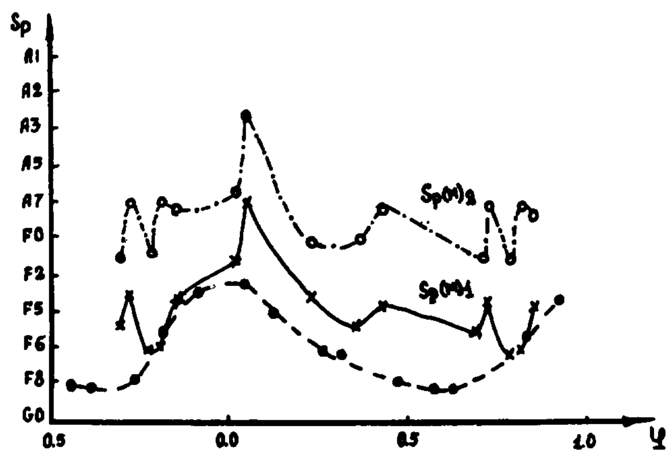


Figure 2

growth into components permits to approximate each of them by the theoretical "curve-of-growth" unambiguously within the range of $\pm$ 50K. Thus it is supposed that the spectra of the cepheid T Vul are mixed, that is there are absorption lines present in them which are formed in the regions with different temperature and other physical conditions. A possible distortion of a continuous spectrum level caused by this seems to be small. The mixed spectrum consists of absorption lines only of those stellar atmospheric regions for which the exposition chosen proved to be the optimal one. In Fig-

Table I. Spectral characteristics of spectrum-forming level of metal absorption lines in T Vul.

φ	0.02	0.04	0.23	0.36	0.42	0.70	0.72	0.78	0.81	0.85
θ_{ex}I	0.917	0.841	0.953	0.968	0.936	0.968	0.936	1.000	0.989	0.946
θ_{ex}2	0.847	0.763	0.884	0.890	0.847	0.900	0.855	0.910	0.855	0.865
SpI	F1.2	A6.4	F4.0	F5.4	F4.0	F5.5	F3.5	F6.4	F6.0	F4.1
Sp2	A6.6	A2.6	F0.1	F0.0	A7.5	F1.0	A7.0	F1.0	A7.0	A8.0

ure 1 the two-component "curve-of-growth" is shown for one of the phases of the main variation of T Vul constructed in coordinates:

$$\lg W_\lambda / \lambda\, 10^6, \qquad \lg fg\lambda - \theta_{ex}\varepsilon$$

On the horizontal axis three scales are represented: one experimental scale $Y = \lg fg\lambda - \theta_{ex}\varepsilon$ and two theoretical scales η_1 and $\eta_2 = Nk/V_t$ (Wrubel, 1949). If the components of "the curve-of-growth" are superimposed from the parameter η_1, η_2, we can be easily convinced in their full coincidence. This confirms the difference in temperatures in forming lines situated in different curves-of-growth and testifies to the quantitative coincidence of the number of iron atoms FeI. Due to this the "curves-of-growth" constructed in the work by Rautela et al. (1981), from the parameter are unambiguous and give the mean value of temperature.

For all the phases of T Vul light variation the two-component "curves-of-growth" are given in the work by Fenina et al. (1989). In Table I the spectral characteristics of the formation level of metal absorption lines in T Vul are represented according to this latter work.

In Figure 2 a complicated character of the variation in the spectral classes is shown depending upon phase ϕ which is due to the layered structure of a spectrum -forming level. Crosses and blank circles correspond to the components of the curve-of-growth Sp(M_1) and Sp(M_2) whereas the dots denote the spectral classes corresponding to the temperatures from work by Rautela et al. (1983) for comparison purposes.

Z.N. FENINA, N.S. ZGONYAIKO, N.D. LEMESHCHENKO
Astronomical Observatory of Odessa State Univ.

References:

Fenina, Z.N., Zgonyaiko, N.S., Lemeshchenko, N.D.: 1989, -Deposited in UkrNIINTI N828-Uk89.

Fenina, Z.N., Zgonyaiko, N.S., Lemeshchenko, N.D.: 1990, IBVS, No.3468.

Rautela, B.S., Sanwal, B., Joshi, S.C.: 1981, Astr. Space Sci., 77, 369.

Rautela, R.S., Joshi, S.C.: 1983, J. Astrophys. Astr., 4, 1.

Wrubel, M.N.: 1949, Ap.J. 109, N1, 66.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3596

Konkoly Observatory
Budapest
3 May 1991
HU ISSN 0374 - 0676

NEW PERIOD FOR GS Cep

The eclipsing binary GS Cep (BD +57°2885) has been observed photoelectrically at the N. Copernicus Observatory and Planetarium in Brno with a 40 cm reflector. As already noted by Hanžl (1990), most of the minima as predicted by the ephemeris given in GCVS (Pri.Min. = HJD 2426350.375 + $0^{d}.772002 \cdot E$ did not appear. It was only possible to satisfy the measurements from the years 1988 and 1989 with a different period, the preliminary value of which was $1^{d}.47162$ [please note that the date in Hanžl (1990), Table II, should read 715 instead of 716]. In order to check the new period, recent measurements have been done during this year in V and B colours (by D.H.). The results obtained are given in Table 1 (where also the times of minima as reported by Hanžl (1990) are repeated). A new ephemeris was calculated using LSM:

$$\text{Pri.Min.} = \text{HJD } \underset{\pm 28}{2447414.4350} + \underset{\pm 6}{1^{d}.471625} \cdot E$$

Table 1
Photoelectric Data

Time of minimum HJD 2440000+	Filter	Epoch	O - C
7414.4346	V	0	-.0004
.4346	B		-.0004
.4359	U		+.0009
7776.4546	V	246	-.0002
.4539	B		-.0009
8060.4838	V	439	+.0054
.4845	B		+.0061
8085.4936	V	456	-.0024
.4936	B		-.0024
8088.4365	V	458	-.0027
.4358	B		-.0034
8102.4205	V	467.5	+.0008
.4198	B		+.0001

Table 2

Sonneberg Plates

HJD 2400000+	Epoch	O-C	HJD 2400000+	Epoch	O-C
38242.524	-6232.5	-.007	41593.454	-3955.5	.032
38371.271	-6145.0	-.029	41596.385	-3953.5	.019
38410.297	-6118.5	-.001	41604.449	-3948.0	-.011
38557.507	-6018.5	.047	42306.408	-3471.0	-.017
38579.531	-6003.5	-.003	42359.363	-3435.0	-.040
38649.375	-5956.0	-.062	42601.506	-3270.5	.021
38813.272	-5844.5	-.240	42713.362	-3194.5	.033
39025.441	-5700.5	.004	42807.268	-3130.5	-.244
39053.389	-5681.5	-.009	42988.506	-3007.5	-.017
39059.378	-5677.5	.094	43008.394	-2994.0	.004
39063.395	-5674.5	-.303	43016.490	-2988.5	.006
39145.368	-5619.0	-.006	44116.492	-2241.0	-.030
39331.534	-5492.5	-.001	44195.280	-2187.5	.025
39359.469	-5473.5	-.027	44456.446	-2010.0	-.023
39443.363	-5416.5	-.016	44823.482	-1760.5	-.157
39671.467	-5261.5	-.013	44846.430	-1745.0	-.019
39685.482	-5252.0	.022	45138.502	-1546.5	-.065
39819.380	-5161.0	.001	45556.496	-1262.5	-.012
40145.382	-4939.5	.038	45674.271	-1182.5	.032
40173.311	-4920.5	.006	45935.436	-1005.0	-.016
40201.260	-4901.5	-.005	45946.374	-997.5	-.115
40476.461	-4714.5	.002	46373.289	-707.5	.029
40501.442	-4697.5	-.035	46648.464	-520.5	.010
40504.426	-4695.5	.006	46704.350	-482.5	-.026
40749.496	-4529.0	.051	46707.346	-480.5	.027
40827.448	-4476.0	.006	47094.342	-217.5	-.015
40914.297	-4417.0	.029	47139.224	-187.0	-.017
41512.483	-4010.5	.000			

It can be seen from the column O-C that the fit is very good. The secondary minimum agrees with the ephemeris too, i.e., the orbit is probably circular. The depths of the primary and secondary minima are $0\overset{m}{.}4$ (in both colours) and $0\overset{m}{.}3$, respectively; the width of both is $0\overset{d}{.}14$.

For many years, the times of minima have been reported as satisfactorily fitting the GCVS ephemeris [determined by Strohmeier et al. (1962)]. Mr. Lichtenknecker kindly sent us the list of all published photographic and visual minima. Some of these 58 minima do agree with our ephemeris - among them also one of two photographic minima observed by P. Frank (in Huebscher et al. 1989). Two of us (P.N., P.H.) estimated the brightness of the star on about 600 plates of the Sonneberg Observatory collection, and found 55 plates with a lower

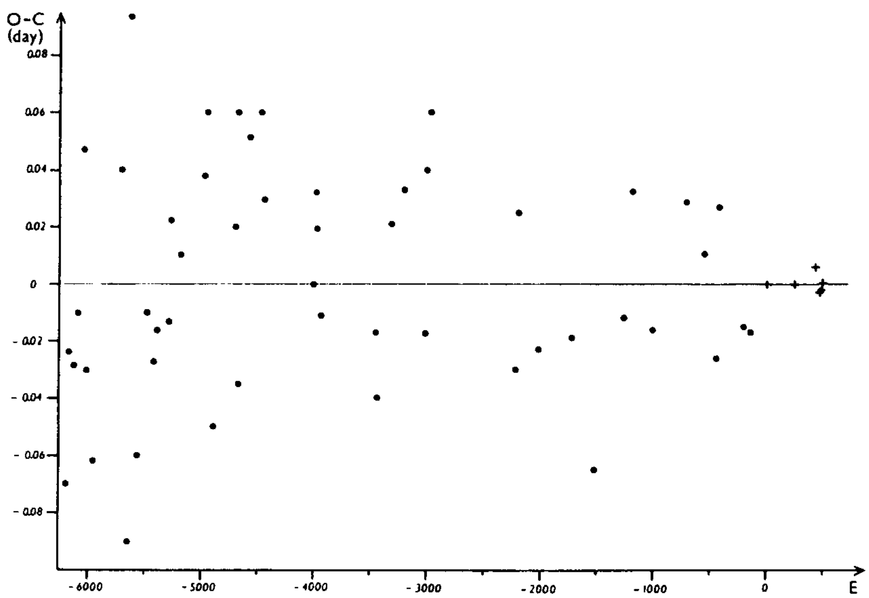


Figure 1 O-C values for the star GS Cep. Dots (•) represent photographic and crosses (+) photoelectric observations

brightness than the rest. These times are listed in Table 2 and illustrated in Figure 1 along with our measurements. With the exception of nine of them, they agree with the new ephemeris (O-C ≤ $0^d.050$). The older - mostly incorrect - visual data probably can be explained by the low amplitude of minima, which is not suitable for visual estimations. The original Bamberg data produced a rather suspicious light curve. The reason why it shows such a large amplitude ($0^m.9$ in the primary minimum) and why the period seemed well determined remains unknown.

D. HANŽL, P. NOVÁK, P. HÁJEK

N.Copernicus Observatory and Planetarium
Kraví Hora, 616 00 Brno

Pavel MAYER

Department of Astronomy and Astrophysics
Charles University
Švédská 8, 150 00 Praha 5

Czechoslovakia

References:

Hanžl, D.: 1990, I.B.V.S., No.3423.
Huebscher, J., Lichtenknecker, D., Wunder, E.: 1989, BAV Mitt. 52.
Strohmeier, W., Knigge, R., Ott, H.: 1962, Bamberg Veröff. 5, N. 15.

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3597

Konkoly Observatory
Budapest
6 May 1991

HU ISSN 0374 - 0676

HD 105759, A NEW SHORT PERIOD VARIABLE STAR

During an observational program on the variable star FG Vir, it turned out that the star HD 105759, used as a check star, shows systematic variation.

This star was not reported in the "Catalog of Stars Suspected of Variability" nor in the more recent edition of the GCVS.

The observations were made during the nights of 1991 March 13, 23; April 03, 13 with the 0.40 m reflector at the "A. Righi" observatory in Reggio Calabria - Italy and given in use at the "Gruppo Astrofili Reggini M31 del DLF". A photomultiplier EMI 9789 QB with Johnson's V filter and photon counting was used.

The elaboration of data obtained on the first two nights showed that HD 105759 had a variation of about 0.05 magn. with respect to HD 105654 with a probable period of 0.045 day.

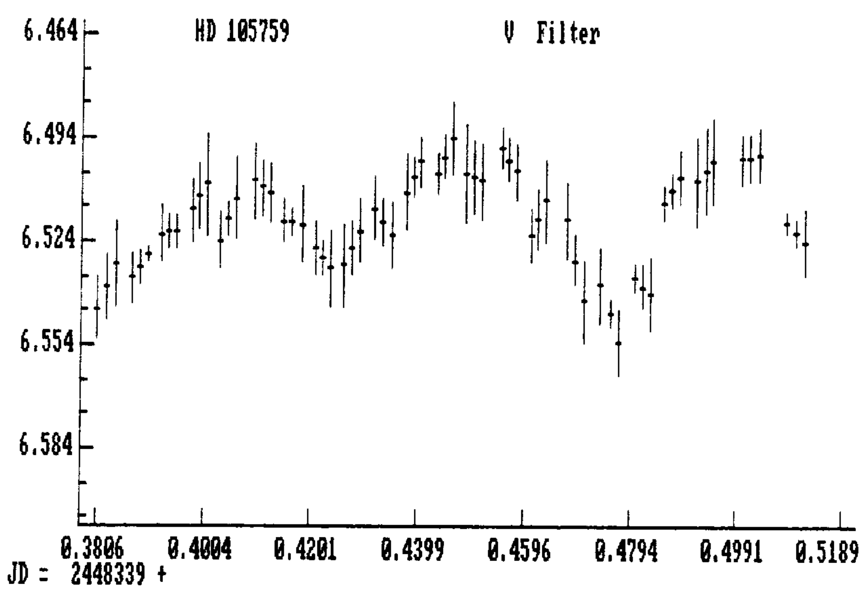


Figure 1 Light curve of HD 105759 in the V filter on March 23th.

The variation was confirmed on the two last nights when HD 105654 and HD 107830 were used as comparison and check stars respectively.

In Figure 1 the magnitude differences with respect to HD 105654 are plotted for the night of 23 March 1991.

A. COLOMBA, G. De BENEDETTO, A. IELO
Gruppo Astrofili Reggini "M31" del DLF
Casella Postale 148
I-89100 Reggio Calabria
Italy

References:

Kholopov, P.N. et al.: General Catalogue of Variable Stars Vol.IV. (Moscow, 1990.)

New Catalogue of Suspected Variable Stars (Nauka, 1982).

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3598

Konkoly Observatory
Budapest
6 May 1991

HU ISSN 0374 - 0676

PHOTOGRAPHIC OBSERVATIONS OF V651 Mon DURING 1988-89

The central star of planetary nebula PK215+3°1 (V651 Mon) has been found to have unstable eclipses since 1981 (Kohoutek, 1982). Since then many authors have made a lot of photometric observations. They have revealed that this object has fast and complex variations in the light curves. We reported previously the photographic observations of the central star of planetary nebula PK215+3°1 for 1981-1986 (Hao, 1987) and 1987 (Hao, 1988). From these observations we have found that its drastic eclipsing light variations, started in 1981, decreased rapidly in 1986 and the eclipse became almost unseen in the light curves of 1987.

Since then we continued the photographic observations during 1988-1989, using the 60/90/180cm Schmidt camera at Xiongliong station of the Beijing Observatory. The observing method and reduction techniques were used as previously described (Hao, 1987).

The new photographic and photovisual observations for V651 Mon during 1988-1989 are presented in Table I. In this table the phases are calculated using the same ephemeris as before (Hao, 1987). In order to make a comparison with the observations in 1987 we also present the light curve of 1987 in Figure 1. The light curves of 1987, 1988, 1989 are plotted on the same magnitude scale.

From these observations we can state that the brightness variations of the central star of planetary nebula PK215+3°1 have an obvious difference between 1987 and 1988. We found that the eclipse events nearly unseen in the light curve of 1987 reappear in the light curves of 1988. The amplitude of the light fluctuations is about 1.1 mag and the "eclipse" occupied roughly 40% of the orbital period. The maximum brightness (m_{pg}) in 1988 was brighter than in 1987. From these it is reasonable to think that the binary central star of planetary nebula V651 Mon might undergo another mass ejection from the sdO component during 1987-1988.

From the observations of 1989 it can be stated that the eclipse event existed in 1989 and its amplitude was about the same as in 1988.

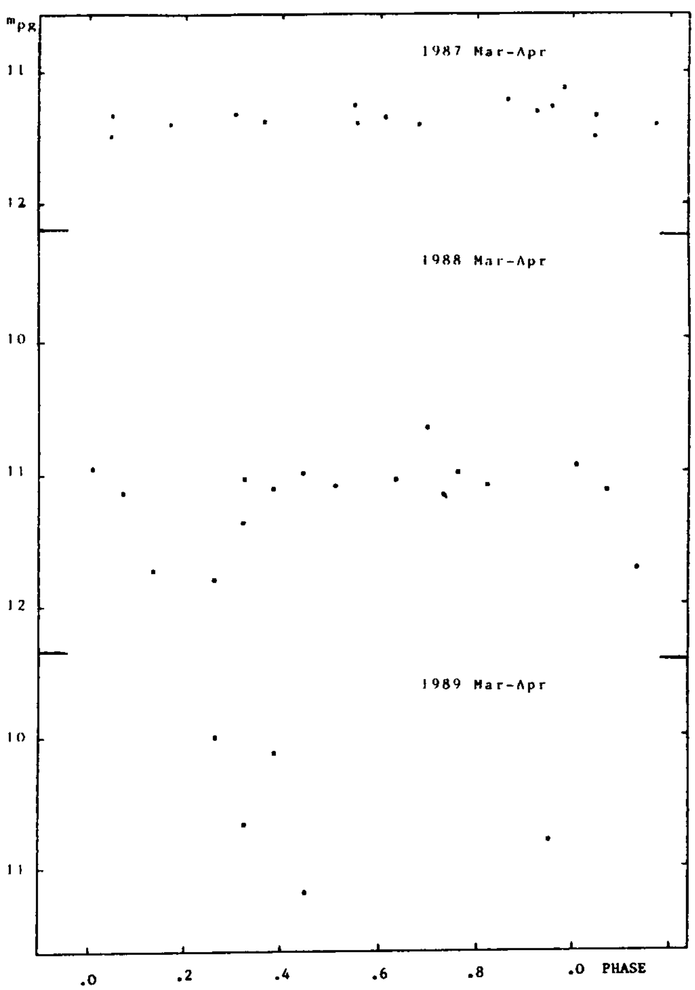


Figure 1. The light curves of V651 Mon

Table I. The Observations of V651 Mon

No.	Plates No. QA-	J.D.hel. 2447000+	M_{pg}	Phase
1	1027	259.325	11.38	0.319
2	1030	260.320	11.12	0.382
3	1031	261.301	11.00	0.443
4	1034	264.331	11.06	0.633
5	1035	265.312	10.67	0.694
6	1038	266.323	11.00	0.758
7	1039	267.364	11.10	0.820
8	1040	270.309	10.96	0.007
9	1043	271.325	11.14	0.071
10	1044	272.317	11.74	0.133
11	1045	274.309	11.80	0.258
12	1048	275.318	11.05	0.322
13	1049	276.306	10.17:	0.383
14	1052	278.319	11.04:	0.509
15	SD-2906	642.344	10.67	0.322
16	-2907	643.345	10.12	0.385
17	-2908	644.349	11.19	0.448
18	-2909	652.349	10.80	0.949
19	-2911	657.345	10.00:	0.262
			M_{pv}	
20	QA-1028	259.334	11.00	0.320
21	1029	260.302	11.03	0.380
22	1032	261.313	11.20	0.444
23	1033	264.506	11.24	0.644
24	1036	265.326	11.05	0.695
25	1037	266.309	11.29	0.757
26	1041	270.325	11.40	0.008
27	1042	271.310	11.50	0.070
28	1046	274.323	11.51	0.259
29	1047	275.307	11.60:	0.321
30	1050	276.319	11.11	0.384
31	1051	278.309	11.52:	0.509
32	SD-2910	657.358	10.96	0.263

HAO XIANG-LIANG

Beijing Observatory
Academia Sinica
Beijing, China

References:

Hao, X.-L.: 1987, IBVS No.3014.
Hao, X.-L.: 1988, IBVS No.3271.
Kohoutek, L.: 1982, IBVS No.2113.

ERRATUM

In the No.3515 issue of the IBVS, in Figure 2 the lowest panel shows the magnitudes of HK Aqr (Gl 890). The star name HR Aqr is erroneously drawn in the Figure.

N.I. BONDAR'

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3599

Konkoly Observatory
Budapest
7 May 1991

HU ISSN 0374 - 0676

New UBV Light Curves of the Early-Type Eclipsing Binary V1331 Aql

New photoelectric UBV light curves and preliminary photometric solutions of the B-type eclipsing binary V1331 Aql (=HD 173198 = SAO 142563 = BD -01° 3553; sp=B1V, period = $1^{d}.364$, V=$7^{m}.7$ at maximum) are presented.

In the past, first photoelectric measurements of V1331 Aql were made by van Leeuwen (1975) with a five-colour Walraven photometer, but the light curves show a considerable scattering. De Freitas Pacheco et al. (1977) published UBV light curves based on a relatively small number of observations and solved it with the Russell-Merrill method and with Wood's WINK code. It is amazing that obviously no further investigations nor observations were dedicated to V1331 Aql until 1990.

Within the scope of a research program to determine absolute dimensions of OB-type eclipsing binaries we measured new photoelectric UBV light curves of V1331 Aql during 10 nights between June 15 and 29, 1990 with the single channel photometer at the ESO 0.5m telescope. An uncooled EMI 9789QB photomultiplier tube was attached. More than 500 individual measurements in each colour were achieved and are shown in Fig. 1. As a comparison star, HD 173003 (V=$7^{m}.7$, sp=B5) was used, which is similar to V1331 Aql in spectral type and magnitude; the non-variability of the comparison was checked with SAO 142571 (V=$9^{m}.8$, sp=B8). No significant variation in the intensity difference between the comparison and this star was found during the observation time.

The differential reduction of the data was made with our own computer code providing relative magnitudes (comparison - variable) and the heliocentric J.D. The transformation in the standard UBV system, which we carried out with a program by L. Kohoutek, yielded the following Johnson magnitudes for the comparison star: U = 7.773 $\pm$ 0.018, B = 8.160 $\pm$ 0.010, V = 7.699 $\pm$ 0.009.

Two primary minima and one secondary minimum of V1331 Aql were covered, what doubles the number of minima times published so far.

Table 1. Normal points for V1331 Aql. N means the number of individual measurements.

Phase	U (HD173003-V1331 Aql)	N	Phase	B (HD173003-V1331 Aql)	N	Phase	V (HD173003-V1331Aql)	N
.00318	-.04811	7	.00372	-.18700	7	.00345	-.32952	7
.00965	-.04242	13	.01020	-.18125	13	.00992	-.32123	13
.01655	-.02704	9	.01709	-.17062	9	.01682	-.31049	9
.02321	-.01395	10	.02375	-.15851	10	.02348	-.29479	10
.03181	.01691	12	.03235	-.12581	12	.03208	-.26649	12
.04565	.06506	9	.04619	-.08093	9	.04592	-.22629	9
.05980	.12074	6	.06034	-.02535	6	.06007	-.16968	6
.10693	.22640	8	.10747	.07096	8	.10720	-.07608	8
.14905	.25050	10	.14680	.09047	10	.14653	-.05361	10
.17372	.26808	12	.17160	.10973	12	.17133	-.03627	12
.19718	.27279	11	.19205	.11722	11	.19178	-.03024	11
.23045	.28697	8	.22172	.12562	8	.23180	-.01984	12
.26848	.29680	12	.26316	.13440	12	.27453	-.01473	14
.29588	.28071	12	.28999	.12566	12	.30539	-.02416	15
.31824	.28137	10	.31239	.11690	10	.33178	-.02890	12
.33987	.27353	11	.33328	.11412	11	.36282	-.04675	14
.36777	.25263	14	.36309	.09548	14	.38118	-.05596	8
.38861	.24944	8	.39195	.08714	8	.40396	-.06180	8
.41172	.23738	8	.41489	.07050	8	.42391	-.09075	9
.42823	.20254	9	.43007	.03994	9	.43874	-.12584	13
.44172	.17165	13	.44334	.00809	13	.45168	-.15794	15
.45407	.14327	15	.45546	-.02255	15	.46527	-.18588	17
.46756	.12090	17	.46898	-.04403	17	.47752	-.20579	10
.48001	.10789	10	.48192	-.06321	10	.48612	-.21717	7
.49114	.09628	7	.49855	-.07589	7	.50182	-.22225	8
.50862	.09746	8	.51638	-.06060	8	.52349	-.19866	10
.52947	.12883	10	.53532	-.02842	10	.53920	-.16946	8
.54422	.15511	8	.55016	.00575	8	.55722	-.12149	12
.56206	.19205	12	.56763	.04432	12	.57614	-.08751	12
.58065	.22161	12	.58724	.06850	12	.60689	-.05757	13
.61562	.25386	13	.62323	.09282	13	.63370	-.04515	12
.64372	.25878	12	.64271	.09678	12	.65601	-.04041	10
.69276	.27812	10	.68821	.11220	10	.71143	-.02377	13
.72628	.28733	13	.72458	.12395	13	.75039	-.01670	17
.76832	.28977	17	.76376	.12643	17	.81052	-.03262	14
.82725	.26559	14	.82367	.10870	14	.83981	-.04174	14
.84871	.24844	14	.84732	.09458	14	.86335	-.05891	15
.87418	.22823	15	.87291	.07889	15	.88652	-.07124	10
.89480	.21881	10	.89388	.06748	10	.90088	-.08103	9
.91082	.20467	9	.90985	.05402	9	.91526	-.09957	8
.92591	.16144	8	.92409	.01507	8	.92940	-.14066	7
.94470	.10074	7	.94276	-.03939	7	.94928	-.20704	9
.95987	.04404	9	.95874	-.09751	9	.96607	-.26456	10
.97510	-.00599	10	.97423	-.14646	10	.98118	-.30730	11
.98785	-.03601	11	.98738	-.17652	11	.99108	-.32200	7
.99662	-.04379	7	.99676	-.18782	8	.99736	-.32964	6

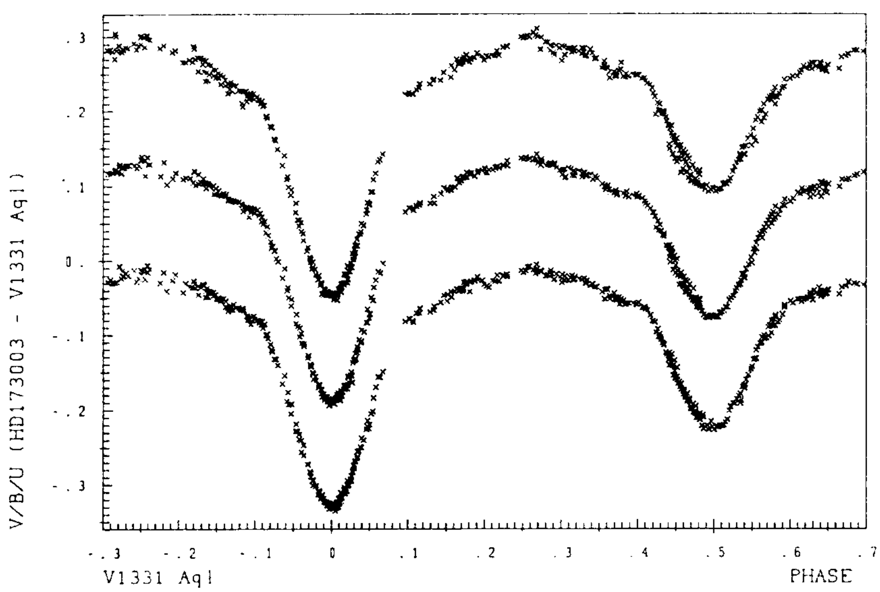


Fig. 1: UBV light curves of V1331 Aql; individual measurements (U top, B middle, V bottom) are differential magnitudes in the sense comparison (HD173003) minus V1331 Aql.

Table 2. Typical light curve solution (l_3 means third light contribution)

$i(^\circ)$	$q(=M_2/M_1)$	T_2(K)	L_2/L_1	l_3(%)	r_1 (mean Roche radii)	r_2 (mean Roche radii)
70.259	0.632	19130	U: 0.313	U: 0.00	0.370	0.283
			B: 0.340	B: 1.41		
			V: 0.363	V: 0.06		

Fixed parameters:

T_1 = 25400 K	$x_1(U)$ = 0.315	$x_2(U)$ = 0.340
$g_{1,2}$ = $A_{1,2}$ = 1.0	$x_1(B)$ = 0.300	$x_2(B)$ = 0.320
	$x_1(V)$ = 0.245	$x_2(V)$ = 0.262

Taking all these data into account we calculated a new period giving the improved ephemeris:

$$\text{Pri.Min.} = \text{hel.J.D. } 2442610.0581 + 1^{d}\!.3641953 \text{ E}$$
$$\pm 1$$

Our 1990 light curves of V1331 Aql were solved using the Wilson-Devinney approach combined with the Simplex parameter optimization procedure (c.f. Kallrath and Linnell, 1987), which is, according to our experiences, superior to the conventional differential corrections method, especially with respect to the convergence behaviour. As input data we used 46 normal points in each colour, formed from 6 to 17 individual measurements each. These normal points are listed in Table 1.

We obtained convergent solutions for several values of q ($=M_2/M_1$) ranging from about 0.6 to 0.8 with nearly equal fit quality. In all cases the system configuration appears to be detached. As the luminosity ratio L_1/L_2 is always about 0.3 and the temperature of the secondary turns out to be around 19000 K (assuming 25400 K for the primary), the most probable model of V1331 Aql is a detached system with both components not too far from ZAMS. Hence, the spectral type of the secondary should be B2.8, and masses of the primary and secondary amount to 13 and 8 $M_{\odot}$, respectively. Then the mass ratio should be about 0.6, a value which is very close to the one we achieved in several light curve solutions (Lorenz et al., 1991). One typical solution is given in Table 2.

The final decision about the mass ratio must be delayed until an independent spectroscopic determination will be available. A radial velocity curve of V1331 Aql will be measured by the authors in July 1991 at the ESO 1.52m spectroscopic telescope.

REINALD LORENZ

HORST DRECHSEL

Dr. Remeis-Sternwarte
Sternwartstr. 7
D-8600 Bamberg, Germany

PAVEL MAYER

Dept. of Astronomy and Astrophysics
Charles University Prague
Svedska 8
CS-150 00 Praha 5 CSFR

References:

de Freitas Pacheco, J.A., Ritté, C., Damineli Neto, A.: 1977, I.B.V.S., No.1306.
Kallrath, J., Linnell, A.P.: 1987, Astrophys.J. 313, 346.
van Leeuwen, F.: 1975, I.B.V.S., No.1041.
Lorenz, R., Drechsel, H., Mayer, P.: 1991, Astron. Ges. Abstract, Ser. 6, 72.

COMMISSION 27 OF THE I.A.U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3600

Konkoly Observatory
Budapest
8 May 1991

HU ISSN 0374 - 0676

SEVEN YEARS OF PHOTOMETRY FOR HR 8752 = V509 Cas

The hypergiant HR 8752 = V509 Cas has been observed photometrically at the Corralitos Observatory for the past seven observing seasons. Some of this work has been previously published (Halbedel 1985,1986,1988). This communication reports on the observations obtained since the last of these papers.

HR 8752 has been previously known to be variable in both spectrum and magnitude. Observed spectral types have ranged from F6 (observed in 1985 by Mantegazza 1988) to K2-5 Ia (Lambert & Luck 1978). Photometrically, the star seems to vary semi-regularly: Percy & Welch (1981) suggest a period of about a year, Ferro (1985) 385 days, and Sheffer & Lambert (1987) 415 days. The most recently published data show that while the star does undergo these semi-periodic changes, the maxima are getting progressively fainter and the star bluer (Halbedel 1988).

HR 8752 has been observed photometrically at the Corralitos Observatory for the past 7 observing seasons with its 0.6-m. telescope and uncooled EMI 9924A tube-based photon-counting photometer. Comparison stars utilized were HR 8761 (V=6.20;B-V=+1.50) and HR 8778 (V=6.43; B-V=+0.90). Over the time period of observation, these two stars were stable to within 0.015 in V and 0.016 in B-V.

The thusfar unpublished Corralitos magnitudes appear in Table 1 and graphically in Figure 1. It may be seen that the trend towards fainter maxima and bluer color has continued.

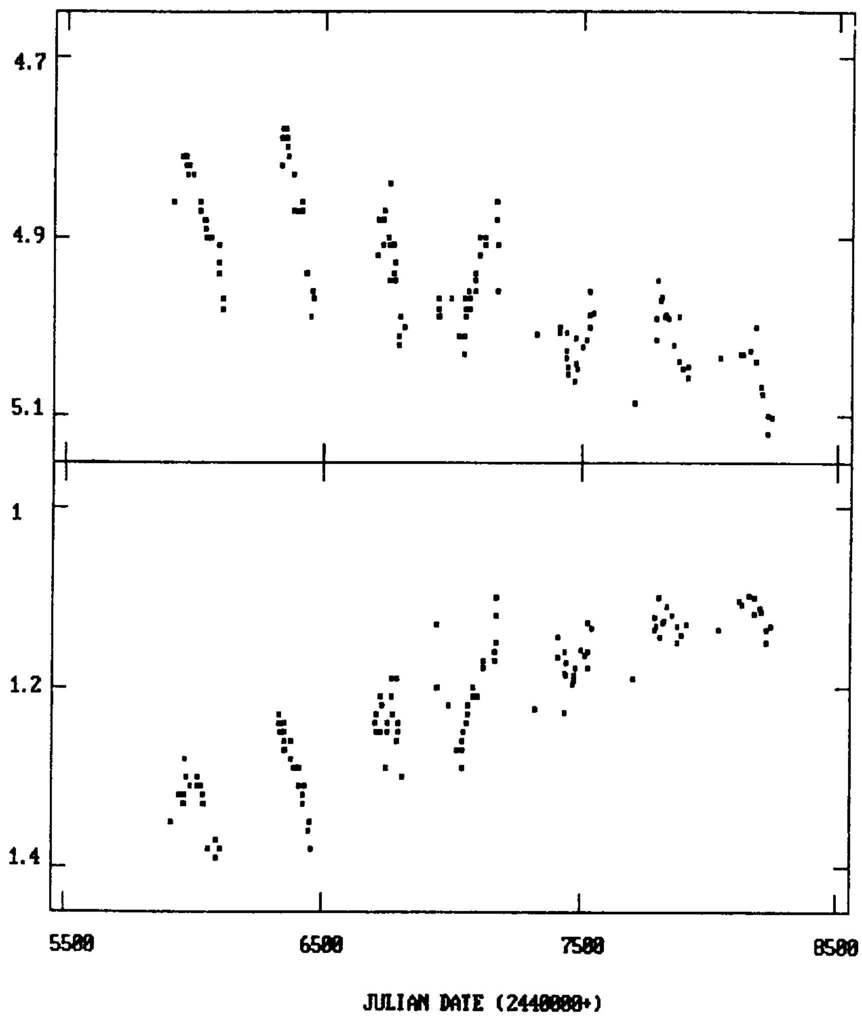


FIGURE 1: MAGNITUDES AND COLORS FOR HR 8752. THE TOP DIAGRAM SHOWS V MAGNITUDE, THE BOTTOM B-V.

The star is fainter now than at any time in the past 7 years. It is also possible that there has been a reduction in the range of each individual cycle, though this may be an effect of time incompleteness of observation. A period search over all 7 years of data utilizing the Minimum Phase

TABLE 1: MAGNITUDES FOR HR 8752

JD (2440000+)	V	B-V	JD (2440000+)	V	B-V
7320.93260	5.009	+1.225	7806.77917	4.971	+1.100
7411.84791	5.000	1.166	7810.74028	4.967	1.145
7412.77708	5.006	1.144	7818.73472	4.989	1.128
7435.82986	5.035	1.184	7827.73819	4.986	1.126
7436.74236	5.006	1.229	7835.69891	4.991	1.111
7437.70763	5.028	1.161	7859.64861	5.021	1.121
7440.73888	5.053	1.173	7878.62638	4.990	1.151
7441.71388	5.044	1.187	7880.58889	5.039	1.133
7470.67777	5.062	1.196	7896.59583	5.046	1.142
7472.68124	5.014	1.186	7915.59236	5.044	1.131
7475.64374	5.041	1.193	7917.58889	5.057	1.130
7477.62847	5.046	1.179	8041.92777	5.036	1.136
7501.66181	5.023	1.158	8122.77986	5.030	1.106
7516.59236	5.015	1.164	8133.82083	5.031	1.109
7525.60972	4.988	1.178	8159.74236	5.028	1.099
7526.58472	5.002	1.129	8176.67778	5.000	1.119
7527.59236	4.962	1.162	8178.71181	5.039	1.101
7540.57777	4.984	1.135	8201.67083	5.068	1.112
7703.91181	5.086	1.191	8204.60833	5.075	1.116
7788.76874	4.991	1.136	8225.61667	5.099	1.136
7790.74028	5.015	1.122	8228.63819	5.120	1.151
7793.80694	4.950	1.133	8244.61806	5.101	1.134

Dispersion Technique of Stellingwerf (1978) finds a best overall period of 409 days, in keeping with previous determinations.

In view of the interesting behavior of this star and the possibility of long-term variations upon which the >1 year long cycles are superimposed, it will continue to be observed at the Corralitos Observatory in the future.

E.M. HALBEDEL

Corralitos Observatory
P.O. Box 16314
Las Cruces, NM
88004-6314 U.S.A.

REFERENCES

Ferro, A. 1985, MNRAS, 216, 571
Halbedel, E.M. 1985, IBVS No. 2718
Halbedel, E.M. 1986, IBVS No. 2876
Halbedel, E.M. 1988, IBVS No. 3170
Lambert, D.L. & Luck, R.E. 1978, MNRAS, 184, 405
Mantegazza, L. 1988 , IBVS No. 3269
Percy, J.R. & Welch, D.L. 1981, PASP, 93, 367
Sheffer, Y. & Lambert, D.L. 1987, PASP, 99, 1277
Stellingwerf, R.F. 1978, ApJ, 224, 953